PHYSIOLOGY (Questions)

1. Normal pH of blood is:  
   a. 7.30  
   b. 7.20  
   c. 7.70  
   d. 7.40

2. Monocytes remains in the circulation for:  
   a. 1-3 days  
   b. 24 hours  
   c. 12 hours  
   d. 6 hours

3. Most common Hemoglobin in normal adult is:  
   a. HbA  
   b. HbF  
   c. HbS  
   d. HbA2

4. Carbon di oxide is transported in plasma as:  
   a. Dissolved form  
   b. Carbamino compounds  
   c. Bicarbonate  
   d. All of the above

5. Most useful method of estimating total iron content of blood:  
   a. Ferritin  
   b. Transferrin  
   c. Erythropoietin  
   d. Lactoferrin

6. Vitamin K dependent clotting factors of hepatic origin are all of the following except:  
   a. II  
   b. VII  
   c. VIII  
   d. X

7. In sickle cell disease:  
   a. Glutamtic acid, at position No.5 of beta-globin chain of haemoglobin is replaced by valine  
   b. Glutamtic acid, at position No.6 of beta-globin chain of haemoglobin is replaced by valine  
   c. Valine at position No.6 of beta-globin chain of haemoglobin is replaced by glutamtic acid  
   d. Valine at position No.5 of beta-globin chain of haemoglobin is replaced by glutamtic acid

8. 1 gm hemoglobin binds with:  
   a. 1.22 ml O₂  
   b. 1.33 ml O₂  
   c. 1.44 ml O₂  
   d. 1.55 ml O₂

9. Substance present in both serum and plasma:  
   a. Fibrinogen  
   b. Factor II  
   c. Factor VII  
   d. Factor V

10. Hemophilia B is deficiency of which factor:  
    a. IX  
    b. XII  
    c. VIII  
    d. X

11. Universal recipients have blood group:  
    a. A  
    b. B  
    c. O  
    d. AB

12. Extrinsic system (blood coagulation) is triggered by the release of:  
    a. Prothrombin  
    b. Thromboplastin  
    c. Fibrinogen  
    d. Thrombin

13. Hagemann factor is involved in:  
    a. Extrinsic pathway  
    b. Intrinsic pathway  
    c. Fibrinolysis  
    d. None

14. Erythropoietin is secreted by:  
    a. Interstitial cells of kidney  
    b. Extraglomerular mesangial cells  
    c. Macula densa  
    d. Renal tubular epithelial cells

15. Plasma makes:  
    a. 20% of Body Weight  
    b. 15% of Body Weight  
    c. 10% of Body Weight  
    d. 5% of Body Weight
16. Heparin inhibits the active form of the following factors except:  
   a. V  
   b. X  
   c. XI  
   d. XII  
   September 2009

17. Autoregulation is seen in:  
   a. Kidney  
   b. Brain  
   c. Muscles  
   d. All of the above  
   March 2010

18. Factor required for erythrocyte stability:  
   a. Ankyrin  
   b. Spectrin  
   c. NADPH  
   d. All of the above  
   March 2010

19. Extrinsic system of coagulation is checked by:  
   a. aPTT  
   b. PT  
   c. BT  
   d. PTT  
   March 2010

20. Reticulocytosis is not seen in:  
   a. Chronic renal failure anemia  
   b. Hemorrhage  
   c. Hereditary spherocytosis  
   d. Paroxysmal nocturnal hemoglobinuria  
   September 2005

21. Hereditary spherocytosis is due to deficiency of:  
   a. Spectrin  
   b. Pyruvate kinase  
   c. Cytokeratin  
   d. Integrin  
   September 2007

22. Raised aPTT is seen in all of the following bleeding disorder except:  
   a. Hemophilia A  
   b. Hemophilia B  
   c. Von-Willebrand disease  
   d. Henoch–Schönlein purpura  
   March 2009

23. Platelets are stored at what temperature:  
   a. 20 degree Celsius  
   b. 15 degree Celsius  
   c. 10 degree Celsius  
   d. 5 degree Celsius  
   September 2010

24. Iron is transported bound to:  
   a. Ferritin  
   b. Transferrin  
   c. Hemosiderin  
   d. Hemoglobin  
   September 2011

25. CVP denotes pressure of:  
   a. Left ventricle  
   b. Left atrium  
   c. Right ventricle  
   d. Right atrium  
   September 2005

26. The first heart sound is due to:  
   a. AV valves closure  
   b. Closing of aortic and pulmonary valves  
   c. Opening of AV valves  
   d. Opening of aortic and pulmonary valves  
   September 2005

27. Cardiac output depends on all of the following except:  
   a. Cardiac rate  
   b. Body surface area  
   c. Stroke volume  
   d. Cardiac contractility  
   September 2005

28. QRS complex is due to:  
   a. Ventricular repolarization  
   b. Atrial depolarization  
   c. Conduction through AV node  
   d. Ventricular depolarization  
   September 2008

29. Vitamin K causes carboxylation of all of the following clotting factors except:  
   a. II  
   b. VII  
   c. VIII  
   d. IX  
   September 2006

30. Mean pulmonary artery pressure is:  
   a. 10 mm Hg  
   b. 15 mm Hg  
   c. 20 mm Hg  
   d. 25 mm Hg  
   September 2007

31. Mean arterial pressure is calculated as:  
   a. Diastolic pressure + 1/3 (Systolic pressure - diastolic pressure)  
   b. Systolic pressure + 1/3 (Systolic pressure - diastolic pressure)  
   c. Diastolic + 1/3rd of systolic pressure  
   d. Arithmetic mean of systolic and diastolic pressures  
   March 2009

32. Blood flow in the vessels supplying the subendocardial portion of left ventricle occurs during:  
   a. Systole  
   b. Diastole  
   c. Throughout the cycle  
   d. Diastole and mid half of systole  
   September 2009
33. Coronary vasodilation is caused by:  
   a. Adenosine  
   b. Noradrenergic stimulation  
   c. Hypocarbia  
   d. All of the above

34. True statement regarding purkinje fibres:  
   a. Are myelinated fibres  
   b. Have action potential about a tenth as long as those in the heart muscle  
   c. Have conduction velocity of four times than that of the heart muscle  
   d. All of the above

35. Negative waves in jugular venous pulse:  
   a. A wave  
   b. V wave  
   c. C wave  
   d. X wave

36. ECG changes seen in hypocalcemia:  
   a. ST segment depression  
   b. Prolongation of ST segment  
   c. Inversion of T wave  
   d. Prolongation of PR segment

37. Left ventricular failure is said to be present if pulmonary capillary wedge pressure exceeds:  
   a. 5 mm Hg  
   b. 10 mm Hg  
   c. 15 mm Hg  
   d. 20 mm Hg

38. The first reactionary change to occur after vessel injury and haemorrhage is:  
   a. Vasoconstriction  
   b. Bradycardia  
   c. Raised cortisol  
   d. Raised adrenaline

39 Increased preload is seen in all of the following except:  
   a. Sympathetic stimulation  
   b. Rest  
   c. Arteriovenous fistula  
   d. Over transfusion of blood

40. Coronary blood flow is maximum during which phase of cardiac cycle:  
   a. Isovolumic relaxation phase  
   b. Isovolumic contraction phase  
   c. Ejection phase  
   d. Isovolumic contraction phase

41. Aortic valve closure corresponds to the beginning of:  
   a. Systole  
   b. Parasytlole  
   c. Isovolumetric relaxation  
   d. Isovolumetric contraction

ENDOCRINOLOGY

42. Anterior pituitary gland secretes all of the following except:  
   a. GH  
   b. TSH  
   c. FSH  
   d. GnRH

43. TSH is normal in:  
   a. Hyperthyroid  
   b. Euthyroid  
   c. Hypothyroid  
   d. Graves

44. Which of the following is not related to the calcium metabolism:  
   a. Calcitonin  
   b. 1, 25-dihydroxycholecalciferol  
   c. Vitamin D  
   d. Thyroxine

45. At what time of the day GH levels are highest:  
   a. 2 hours after sleep  
   b. 2 hours before sleep  
   c. Evening  
   d. Early morning

46. Fasting blood sugar in normal individuals is:  
   a. 80-100 mg/100 ml  
   b. 100-120 mg/100 ml  
   c. 120-140 mg/100 ml  
   d. 140-160 mg/100 ml

47. True regarding glucose tolerance test are all except:  
   a. Can be done in fasting as well as post prandial state  
   b. 1 gram of glucose/kg body weight is administered  
   c. Glucose levels are checked after 2 hours  
   d. Diagnosis of diabetes mellitus can be established
48. Which one of the following statements describes diabetes mellitus:  
   a. Rise of blood sugar of 50 mg/100 ml in oral glucose tolerance test  
   b. Fasting blood sugar value more than 200 mg/100ml  
   c. Post prandial rise of blood sugar more than 50 mg/100 ml  
   d. All of the above  

49. Which of the following causes hypocalcemia:  
   a. Parathormone  
   b. Thyroid hormones  
   c. Calcitonin  
   d. 1, 25-dihydroxycholecalciferol  

50. The hormone which helps in milk secretion:  
   a. Oxytocin  
   b. Growth hormone  
   c. FSH  
   d. Prolactin  

51. Features like hypogonadism, dwarfism, loss of hair, pigmentation and ulcers of skin and decreased immunity are associated with deficiency of:  
   a. Iron  
   b. Zinc  
   c. Iodine  
   d. Copper  

52. Long term status of blood sugar is explained by:  
   a. HbA  
   b. Serial measurement of FBS  
   c. Oral glucose tolerance test  
   d. Hba1c  

53. Suprarenal medulla secretes which hormones:  
   a. Glucocorticosteroids  
   b. Catecholamines  
   c. Androgens  
   d. Mineralocorticoids  

54. Chronic atrophy of adrenal gland will result in which hormone deficiency:  
   a. CRH  
   b. ACTH  
   c. Cortisol  
   d. MSH  

55. Procedure of glucose tolerance test is:  
   a. Glucose load in fed state, measurement of blood glucose after 2 hours  
   b. Glucose load in fasting state, measurement of blood glucose after 2 hours  
   c. Glucose load in fasting state, measurement of urinary glucose after 2 hours  
   d. Glucose load in fed state, measurement of urinary glucose after 2 hours  

56. Corticosteroids suppress:  
   a. GH  
   b. ACTH  
   c. FSH  
   d. LH  

57. Thyroxine levels are raised in:  
   a. Myxedema  
   b. Endemic goitre  
   c. Idiopathic nontoxic colloid goitre  
   d. Grave’s disease  

58. True about Chvostek’s sign are all of the following except:  
   a. Denotes neuromuscular hyperexcitability  
   b. Elicited over face  
   c. Raised calcium level  
   d. Facial nerve is stimulated by tapping  

59. Hypocalcemia results in  
   a. Absent tendon reflexes  
   b. Shortened QT interval in ECG  
   c. Reduced excitability of nerves and muscle cells  
   d. Tetany  

60. Which of the following is seen in cold temperature:  
   a. Increased Thyroxine release  
   b. Decreased Thyroxine release  
   c. Unaltered Thyroxine release  
   d. None of the above  

61. During surgical stress, which is not seen:  
   a. Increased ACTH  
   b. Increased insulin  
   c. Increased norepinephrine  
   d. Increased GH  

62. Normal glomerular capillary pressure:  
   a. 15  
   b. 25  
   c. 35  
   d. 45
63. Substance which is not absorbed in the loop of Henle: 
   a. K⁺ 
   b. Urea 
   c. Cl⁻ 
   d. Na⁺ 

64. Reabsorption of Water is maximum in: 
   a. PCT 
   b. DCT 
   c. Collecting duct 
   d. Loop of henle 

65. Glomerular filtration rate increases if: 
   a. Increased plasma oncotic pressure 
   b. Decreased glomerular hydrostatic pressure 
   c. Increased renal blood flow 
   d. Increased tubular hydrostatic pressure 

66. Substance used to measure renal perfusion: 
   a. Inulin 
   b. PAH 
   c. Creatinine 
   d. Mannitol 

67. True regarding water absorption in tubules: 
   a. Majority of facultative reabsorption occurs in proximal tubule 
   b. Bulk of water reabsorption occurs secondary to sodium absorption 
   c. 25% of water is reabsorbed irrespective of water balance 
   d. Obligatory reabsorption is ADH dependent 

68. Site of action of ADH is: 
   a. PCT 
   b. Vasa recta 
   c. Loop of henle 
   d. Collecting ducts 

69. What is glomerular filtration rate? 
   a. 100 ml/min 
   b. 125 ml/min 
   c. 150 ml/min 
   d. 175 ml/min 

70. Active resorption of sodium ion occurs in: 
   a. Ascending loop of henle 
   b. Early distal tubule 
   c. Proximal tubule 
   d. All of the above 

71. PCT absorbs all except: 
   a. Sodium 
   b. Amino acids 
   c. Glucose 
   d. Hydrogen ions 

72. Glucose is reabsorbed at: 
   a. PCT 
   b. DCT 
   c. Collecting duct 
   d. All of the above 

73. Maximum absorption of NaCl in proximal convoluted tubule occurs due to the effect of: 
   a. ADH 
   b. Aldosterone 
   c. Atrial natriuretic peptide 
   d. Angiotensin II 

74. ANP acts at the: 
   a. Proximal tubule 
   b. Distal tubule 
   c. Collecting tubule 
   d. Henle loop 

75. GFR decreases with the following: 
   a. Hypoproteinemia 
   b. Hypotension 
   c. Hypertension 
   d. All of the above 

76. Urinary concentrating ability of kidney increases if there is: 
   a. Increase in renal blood flow 
   b. Increase in GFR 
   c. Decrease in medullary hyperosmolarity 
   d. Contraction in extracellular fluid volume 

77. Which is not a constituent of juxtaglomerular complex: 
   a. Macula densa 
   b. Glomerulus 
   c. Juxtaglomerular cells 
   d. Extraglomerular mesangial cells 

78. Aldosterone acts chiefly on which of the following cells: 
   a. DCT 
   b. PCT 
   c. Loop of Henle 
   d. Glomerulus
79. Faecal mass is mainly derived from:  March 2005
   a. Undigested food
   b. Digested food
   c. Intestinal secretions
   d. Intestinal flora

80. Most potent stimulus for bile secretion is:  September 2005
   a. Gastrin
   b. Bile acid
   c. Bile salt
   d. Secretin

81. Rapidly absorbed in the stomach is:  September 2006
   a. Protein
   b. Carbohydrate
   c. Fat
   d. None

82. Which of the following is not produced by hepatocytes:  September 2006
   a. Gamma globulin
   b. Albumin
   c. Fibrinogen
   d. Prothrombin

83. Urobilinogen is formed in the:  September 2006
   a. Liver
   b. Kidney
   c. Intestine
   d. Spleen

84. Chymotrypsinogen is activated into chymotrypsin by:  March 2007
   a. Trypsin
   b. Pepsin
   c. Renin
   d. HCl

85. Ion which promotes glucose absorption in the gut region:  September 2007
   a. Cl⁻
   b. K⁺
   c. Na⁺
   d. Ca²⁺

86. ADEK deficiency is seen in:  September 2007
   a. Malabsorption syndrome
   b. Obstructive jaundice
   c. Deficiency of pancreatic lipase
   d. All of the above

87. Kupffer cells in the liver are:  March 2008
   a. Endothelial cells
   b. Secretory cells
   c. Phagocytic cells
   d. Excretory cells

88. True about active absorption of iron is:  March 2009
   a. Absorbed in distal ileum
   b. Absorbed in stomach
   c. Not absorbed in duodenum and proximal jejunum
   d. Decreases following gastrectomy

89. Mechanism involved in the absorption of glucose from small intestine is which of the following:  March 2005
   a. Active co-transport with sodium
   b. Passive diffusion
   c. Facilitated diffusion
   d. Active co-transport with potassium

90. Causes of vitamin B12 deficiency is:  September 2006
   a. Lack of intrinsic factor
   b. Diseases affecting terminal ileum
   c. Fish tapeworm infestation
   d. All of the above

91. Salivary amylase is activated by:  March 2007
   a. Sodium Ion
   b. Chlorine Ion
   c. Potassium Ion
   d. Bicarbonate Ion

92. Iron binding protein is  September 2010
   a. Ferritin
   b. Ferroportin 1
   c. Transferrin
   d. Hephaestin

93. Which of the following decreases intestinal motility:  March 2011
   a. CCK
   b. Serotonin
   c. Gastrin
   d. Secretin

94. Which of the following inhibits gastric phase of gastric secretion:  March 2011
   a. Amino acids in stomach
   b. Vagus effect
   c. Distension of the stomach
   d. Low gastric pH
95. Bipolar cells is seen in:  
   a. Sympathetic ganglion  
   b. Retina  
   c. Cochlear ganglion  
   d. Parasympathetic ganglion  

96. All are carried through anterolateral system except:  
   a. Proprioception  
   b. Temperature  
   c. Pain  
   d. Crude touch  

97. All or none law is obeyed by:  
   a. Post synaptic potential  
   b. Non propagated potential  
   c. Action potential  
   d. Spike potential  

98. Sensory fiber with least conduction velocity:  
   a. C- fiber  
   b. Alpha fiber  
   c. beta fiber  
   d. Gamma fiber  

99. All are primary colours except:  
   a. Green  
   b. Blue  
   c. Red  
   d. White  

100. True about colour blindness:  
    a. Autosomal dominant inheritance  
    b. Tritanopia is the commonest disorder  
    c. Trichromats are unable to appreciate blue colour  
    d. Defect in 1 or more prime colours  

101. True about semicircular canals:  
    a. Submerged in a fluid called endolymph  
    b. Base of cupula is in close contact with afferent fibres of cochlear division of the eight cranial nerve  
    c. Arranged at right angles to each other  
    d. Associated with hearing  

102. Blind spot of mariotte:  
    a. Fovea centralis  
    b. Optic disc  
    c. Macula lutea  
    d. Ors serrata  

103. Stretch reflex of urinary bladder is integrated at:  
    a. Sacral portion of spinal cord  
    b. Lumbar portion of spinal cord  
    c. Substantia gelatinosa  
    d. Sympathetic plexus  

104. Function of neocerebellum is:  
    a. Maintaining posture and equilibrium  
    b. Planning and programming of voluntary movements  
    c. Maintenance of muscle tone  
    d. Proprioception  

105. All of the following are concerned with spatial orientation:  
    a. Vestibular receptors  
    b. Eyes  
    c. Proprioceptors in joint capsule  
    d. All of the above  

106. A cut /lesion above the pyramidal tract decussation results in:  
    a. Paralysis of the opposite half of the body  
    b. Contralateral loss of proprioception  
    c. Ipsilateral loss of pain and temperature  
    d. Contralateral loss of vibration and joint position  

107. Which lies in the dorsal column of spinal cord:  
    a. Fasciculus gracilis  
    b. Anterior spinothalmic tract  
    c. Dorsal spinocerebellar tract  
    d. Ventral spinocerebellar tract  

108. Phantom limb is explained by:  
    a. Webers law  
    b. Law of projection  
    c. Fechners law of degeneration  
    d. Pascals law  

109. Clasp knife rigidity is also known as:  
    a. Inverse stretch reflex  
    b. Withdrawl reflex  
    c. Lengthening reaction  
    d. Crossed extensor reflex  

110. Neurotransmitter depleted in Parkinson’s disease:  
    a. Dopamine  
    b. Acetylcholine  
    c. Glutamate  
    d. GABA
111. Function of flocculodular lobe of cerebellum is:  
   March 2008  
   a. Co-ordination of movements  
   b. Equilibrium  
   c. Chemoreception  
   d. Planning of movements  

112. Limbic system is concerned with all except:  
   March 2008  
   a. Higher function  
   b. Emotion  
   c. Memory  
   d. Planned motor activity  

113. Alpha wave in EEG are seen in:  
   March 2008  
   a. Mental work  
   b. Awake state  
   c. Sleep  
   d. REM sleep  

114. Features of occipital lobe of brain are all except:  
   March 2008  
   a. Visual cortex lies in relation to calcarine fissure  
   b. Brodmann’s area 17 corresponds to visual cortex  
   c. Geniculocaroline fibres from the medial half of the lateral geniculate terminate on the superior lip of the calcarine fissure  
   d. Its the only area in the brain activated by visual stimuli  

115. Dreaming is common in which stage of sleep:  
   September 2008  
   a. REM  
   b. NREM 1  
   c. NREM 2  
   d. NREM 3  

116. White colour vision/Perception of white light is due to:  
   September 2008  
   a. Stimulation of red cones more than blue or green  
   b. Stimulation of blue cones more than red or green  
   c. Stimulation of green cones more than blue or red  
   d. Stimulation of red, blue and green cones equally  

117. All are Neuroglial cells in the CNS except:  
   September 2008  
   a. Oligodendrocytes  
   b. Microglia  
   c. Astrocytes  
   d. Kupffer cells  

118. True regarding movements of the cilia in the inner ear are all except:  
   March 2009  
   a. It moves when head is rotated  
   b. It moves when moving person suddenly stops  
   c. It moves when perilymph moves  
   d. Its movement is guided by the inertia of endolymph  

119. Electrical response, due to the effect of light on photosensitive compounds of rods and cones:  
   March 2009  
   a. Hyperpolarisation occurs  
   b. Depolarisation occurs  
   c. Spike potential is generated  
   d. None of the above  

120. Maximum number of sodium channels per square micrometer, is present in:  
   March 2009  
   a. Cell body  
   b. Axon terminal  
   c. Surface of myelin  
   d. Nodes of Ranvier  

121. Sweating is mediated by:  
   March 2009, September 2010  
   a. Cholinergic mediated sympathetic activity  
   b. Noradrenergic mediated sympathetic activity  
   c. Noradrenergic mediated parasympathetic activity  
   d. Cholinergic mediated parasympathetic activity  

122. Function of a muscle spindle is:  
   September 2009  
   a. Regulates withdrawl reflex  
   b. Maintains muscle tone  
   c. Feedback device to maintain muscle length  
   d. Receptor for inverse stretch reflex  

123. Sensory organ for responding to texture is:  
   September 2009  
   a. Meissner corpuscles  
   b. Merkel cells  
   c. Ruffini corpuscles  
   d. Pacician corpuscles  

124. Acetylcholine receptors are decreased in:  
   September 2009  
   a. Lambert–Eaton syndrome  
   b. Parkinson disease  
   c. Alzheimer disease  
   d. Myasthenia gravis  

125. All of the following are cholinergic effects except:  
   September 2009  
   a. Tachycardia  
   b. Salivation  
   c. Miosis  
   d. Bronchoconstriction
126. Properties of alpha waves are all of the following except:
   a. It is most marked in the parieto-occipital area
   b. It has a frequency of 8–12 Hz
   c. Frequency is decreased by low glucose level
   d. Seen in REM sleep

127. Melatonin is associated with all of the following except:
   a. Vomiting
   b. Pituitary gland secretion
   c. Sleep mechanism
   d. Jetlag

128. All of the following effects can occur if vagus is stimulated, except:
   a. Reduction in blood pressure
   b. Increase in secretions of the intestine
   c. Intestinal musculature constriction
   d. Bronchial musculature relaxation

129. Influx of which of the following ion is responsible for IPSP:
   a. Potassium ion
   b. Chloride ion
   c. Calcium ion
   d. Sodium ion

130. Delta waves on EEG are recorded in:
   a. REM
   b. 01 NREM
   c. 02 NREM
   d. Deep sleep

131. Temperature regulation is chiefly under the control of:
   a. Midbrain
   b. Pons
   c. Medulla
   d. Hypothalamus

132. Vomiting centre is situated in the:
   a. Hypothalamus
   b. Midbrain
   c. Pons
   d. Medulla

133. Optic nerve is:
   a. 1st order neuron
   b. 2nd order neuron
   c. 3rd order neuron
   d. 4th order neuron

134. Which of the following is not carried in dorsal column of spinal cord:
   a. Proprioception
   b. Vibratory sense
   c. Heat sensation
   d. Touch

135. Which of the following is not associated with temporal lobe:
   a. Audition
   b. Memory
   c. Spatial relationship
   d. Behaviour

136. Correct statement regarding high altitude:
   a. Po2 is less
   b. Pco2 is more
   c. In the air, percentage of oxygen is less
   d. Decrease in number of RBC’s

137. Less O2 saturation in blood is seen in:
   a. R-L shunt
   b. LV obstruction
   c. RV obstruction
   d. L-V shunt

138. Shift to right in Oxygen dissociation curve is seen in all except:
   a. Increased PaCO2
   b. Decreased PaCO2
   c. Increase in 2, 3 DPG
   d. Decreased pH

139. Which is responsible for respiratory drive:
   a. O2
   b. CO
   c. CO2
   d. Bicarbonate ions

140. Regarding lung volumes, which of the following is true:
   a. Functional residual capacity accounts for 75% of total lung capacity
   b. Residual volume keeps alveoli inflated between breaths
   c. Vital capacity increases in elderly
   d. Residual volume is about 500 ml
141. Bohr effect is described as:  
   a. Decrease in CO₂ affinity of hemoglobin when the pH of blood rises  
   b. Decrease in CO₂ affinity of hemoglobin when the pH of blood falls  
   c. Decrease in O₂ affinity of hemoglobin when the pH of blood rises  
   d. Decrease in O₂ affinity of hemoglobin when the pH of blood falls

142. Vagal stimulation causes:  
   a. Increase in rate of respiration  
   b. Increase in depth of respiration  
   c. Bronchodilation  
   d. Decreased depth of respiration

143. Surfactant is produced by:  
   a. Alveolar macrophages  
   b. Lymphocytes in the alveoli  
   c. Type I alveolar cells  
   d. Type II alveolar cells

144. Haldane effect is defined as:  
   a. Important mechanism meant for oxygen transport in the body  
   b. Binding of oxygen to hemoglobin increases capacity for carbon dioxide  
   c. Deoxygenation of blood increases capacity for carbon dioxide  
   d. All of the above

145. Complete apneusis will result if transection is done at:  
   a. Lower Pons  
   b. Lower Medulla  
   c. Midbrain  
   d. Cerebellum

146. Which of the following is seen at high altitude:  
   a. Low PaO₂  
   b. High PaO₂  
   c. Normal PaO₂  
   d. High PaCO₂, Low PaO₂

147. Which of the following describes In vitro fertilization:  
   a. Method to judge the time of ovulation so that coitus can result in fertilization  
   b. Use of hormones to promote fertilization in the tubes  
   c. Removing mature ova, fertilizing it with sperm and implanting back in uterus  
   d. Artificial insemination

148. Ovulation is due to surge of:  
   a. FSH  
   b. LH  
   c. Prolactin  
   d. TSH

149. Milk ejection is facilitated by:  
   a. Oxytocin  
   b. Growth hormone  
   c. FSH  
   d. LH

150. Separation of first polar body occurs at the time of:  
   a. Fertilization  
   b. Ovulation  
   c. Implantation  
   d. Menstruation

151. All of the following are indicators of ovulation except:  
   a. Increase in cervical mucus  
   b. Abdominal cramps  
   c. LH surge  
   d. Fall in body temperature

152. Fertilization occurs in which part of the fallopian tube:  
   a. Fimbrial  
   b. Isthmus  
   c. Ampulla  
   d. Interstitial

153. Sperm becomes mobile in:  
   a. Vas deferens  
   b. Prostatic urethra  
   c. Testis  
   d. Epididymis

154. Asthenospermia means:  
   a. Reduction in number of sperms  
   b. Reduction in motility of sperms  
   c. Absence of sperms  
   d. Absence of semen

155. Ovulation occurs:  
   a. 14 days after menstruation  
   b. 14 days prior to next menstruation  
   c. On 14th day of the cycle  
   d. None of the above
156. Term period for embryonic period: September 2006
   a. 0-14 days of gestation
   b. 14 days to 9 weeks of gestation
   c. 9 weeks to birth
   d. 22 weeks intrauterine to 7 days after birth

157. Impotency may be seen in: September 2007
   a. Mumps orchitis
   b. Testosterone deficiency
   c. Prolactinoma
   d. All of the above

158. Testosterone production is mainly contributed by: March 2011, September 2011
   a. Leydig cells
   b. Sertoli cells
   c. Seminiferous tubules
   d. Epididymis

159. Interstitial cells (of Leydig) in testes secrete which of the following: March 2011
   a. Inhibin
   b. Testosterone
   c. Anti-mullerian hormone
   d. Aromatase

160. Levels of which of the following hormones are increased in post menopausal women: September 2011
   a. Estrogen
   b. FSH
   c. Progesterone
   d. Cortisone

161. Characteristic of smooth muscle cells in intestine: March 2005
   a. Does not have actin and myosin
   b. Cannot do sustained contraction
   c. It contracts when stretched in the absence of any extrinsic innervation
   d. Does not require calcium for contraction

162. Osmolality of plasma in a normal adult: September 2005
   a. 320-330 mOsm/L
   b. 300-310 mOsm/L
   c. 280-290 mOsm/L
   d. 260-270 mOsm/L

163. Hydrogen ion is eliminated by: September 2005
   a. Kidney
   b. Lungs
   c. Liver
   d. Stomach

164. Which ion helps is resting membrane potential in neurons: September 2005
   a. Potassium
   b. Calcium
   c. Chloride
   d. Sodium

165. Metabolic acidosis is seen in all except: September 2005
   a. Diabetic ketoacidosis
   b. Emphysema
   c. Aspirin overdose
   d. Uremia

166. Magnitude of action potential is mainly affected by: September 2005
   a. Calcium ion
   b. Hydrogen ion
   c. Sodium ion
   d. Potassium ion

167. Type of exercise done to increase the muscle strength: September 2005
   a. Aerobic isotonic
   b. Isometric
   c. Isotonic
   d. All of the above

168. Nicotinic receptors are seen in all except: September 2007
   a. Neuromuscular junction
   b. Autonomic ganglia of autonomic nervous system
   c. Bronchial smooth muscle
   d. Brain

169. Normal limit for postprandial (after 2 hours) blood glucose level (in mg/dL): March 2008
   a. 80-110
   b. 110-140
   c. 140-170
   d. 170-200

170. BMI of underweight individual: March 2008
   a. Less than 18.5
   b. 18.5-24.9
   c. 25-29.9
   d. More than 30

171. Most abundant ion in intracellular fluid is: September 2008
   a. Protein
   b. Bicarbonate
   c. Potassium
   d. Sodium

172. Nearly 20% of normal tensile strength of tissue at the site of wound is gained after: September 2008
   a. 1 week of wound healing
   b. 2 weeks of wound healing
   c. 3 weeks of wound healing
   d. 4 weeks of wound healing
173. Major contribution to plasma osmolality is by which ion:  
   a. Sodium  
   b. Potassium  
   c. Glucose  
   d. Calcium  

   March 2009

174. All of the following changes are seen in chronic starvation except:  
   a. All fat stores have been used up  
   b. Severe fat and muscle wasting  
   c. Brain uses ketoads as fuel  
   d. Level of serum proteins less than 2.8 g/dL  

   September 2009

175. Repolarization of a nerve is due to:  
   a. Hydrogen ions  
   b. Potassium ions  
   c. Sodium ions  
   d. Calcium ions  

   September 2009

176. Which interleukin is needed for differentiation of eosinophils:  
   a. IL1  
   b. IL2  
   c. IL4  
   d. IL5  

   September 2009

177. Bicarbonate exchange occurs in:  
   a. Kidney  
   b. Lung  
   c. None of the above  
   d. Both of the above  

   September 2009

178. Size of action potential is decreased as a result of:  
   a. Lower extracellular sodium  
   b. Raised extracellular calcium  
   c. Lower extracellular calcium  
   d. Raised extracellular sodium  

   March 2010

179. With glucose which of the following is transported:  
   a. Hydrogen ions  
   b. Potassium ions  
   c. Calcium ions  
   d. Sodium ions  

   March 2010 and 2011

180. During pregnancy, deficiency of which vitamin in women causes neural tube defect in the newborn:  
   a. Thiamine  
   b. Pyridoxine  
   c. Folic acid  
   d. Cyanocobalamin  

   March 2010

181. What is the BMI for obese person:  
   a. Less than 18.5  
   b. 18.5-24.9  
   c. 25-29.9  
   d. More than 30  

   March 2010

182. A disease occurring before 65 yr of age is termed as:  
   a. Senile  
   b. Pre senile  
   c. Post adolescent  
   d. Post senile  

   September 2007

183. Main content of bilayer cell membrane is:  
   a. Glycerol  
   b. Cholesterol  
   c. Cholesterol ester  
   d. Triacyl glycerol  

   March 2009

184. Oily substance secreting gland is:  
   a. Sweat gland  
   b. Meibomian gland  
   c. Salivary gland  
   d. Lacrimal gland  

   September 2009

185. Which of the following is true:  
   a. ExtraCellular Fluid is rich in organic anion  
   b. ECF is more than IntraCellular Fluid  
   c. High sodium to potassium ratio is seen in ECF  
   d. ECF is potassium ion rich  

   September 2010

186. Red reaction in triple response is due to:  
   a. Local edema  
   b. Capillary dilation  
   c. Axon reflex  
   d. Decreased permeability of capillaries  

   March 2011

187. Which of the following may be the effect of positive ‘g’ acceleratory force on the body of aviator:  
   a. Increased cardiac output  
   b. Initial rise and then fall of blood pressure  
   c. Thrombocytopenia  
   d. Pooling of blood in lower body  

   September 2011

188. Fibrillation of skeletal muscle is associated with all except:  
   a. Long time after denervation  
   b. Hypersensitivity to acetylcholine  
   c. Lot of receptors over entire muscle cell membrane  
   d. Strong stimulus  

   March 2011
1. Normal pH is 7.35-7.45. There are a series of buffers which help the plasma resist any change in pH. Some of them include: the hemoglobin in the red blood cells, other plasma proteins, the bicarbonate buffer and the phosphate buffer.

   Ans. D: 7.40
   Ref.: Ganong’s Physiology 23rd ed., Page-4

2. Monocytes enter the circulation from the bone marrow and remains in circulation for about 72 hours. They then enter the tissues and become tissue macrophages. The tissue macrophages include Kupffer cells of liver, pulmonary alveolar macrophages and microglia in the brain.

   Ans. A: 1-3 days
   Ref.: Ganong’s Physiology 23rd ed., Page-65

3. In the embryo-Gower 1 (ζ2ε2) Gower 2 (α2ε2)
   In the fetus: hemoglobin F (α2γ2)
   In the adults:
   Hemoglobin A (α2β2) - The most common with a normal amount over 95%
   Hemoglobin A2 (α2δ2) - β chain synthesis begins late in the third trimester and in adults, it has a normal range of 1.5-3.5%
   Hemoglobin A1c is increased in the patients with poorly controlled diabetes mellitus.

   Ans. A: HbA
   Ref.: Ganong’s Physiology 23rd ed., Page-523,526

4. CO2 is carried in blood in three different ways
   1. Most of it (about 70% – 80%) is converted to bicarbonate ions by the enzyme carbonic anhydrase in the red blood cells
   2. 5% – 10% is dissolved in the plasma
   3. 5% – 10% is bound to hemoglobin as carbamino compounds

   Ans. D: All of the above
   Ref.: Ganong’s Physiology 23rd ed., Page-613

5. Iron is absorbed in ferrous (Fe2+) form in the duodenum.
   Ferritin is the storage form of iron.
   Transferrin is iron transporter protein
   70% of iron in the body is hemoglobin
   Ferritin which is not combined with iron is called apoferritin.
   Under steady conditions, the serum ferritin level correlates with total body iron stores; thus, the serum ferritin level is the most convenient laboratory test to estimate iron stores.
   The ferritin levels measured have a direct correlation with the total amount of iron stored in the body.
If ferritin is high there is iron in excess. If ferritin is low there is a risk for lack in iron.
Serum ferritin is the most sensitive lab test for iron deficiency anemia.
Ferritin is also used as a marker for iron overload disorders, such as hemochromatosis and porphyria in which the ferritin level may be abnormally raised.

**Ans. A: Ferritin**
*Ref.: Guyton’s Physiology 11th ed., Page-425*

6. **Ans. C: VIII**
*Ref.: Guyton’s Physiology 11th ed., Page-862*

7. Sickle haemoglobin (HbS) is a structural variant of haemoglobin in which glutamic acid, an amino acid, at position No.6 of beta-globin chain of haemoglobin is replaced by valine.
This happens due to change of a nucleotide, adenine to thymine (GAG→GTG) of codon 6 of beta-globin gene. This substitution of amino acid changes the net charge of haemoglobin, oxygen affinity and three-dimensional structure thus rendering it as unstable haemoglobin.
Sickle haemoglobin gets polymerized at low oxygen tension and deforms the red blood cell from discoid shape to sickle like (crescent) form.

**Ans. B: Glutamic acid, at position No.6 of beta-globin chain of haemoglobin is replaced by valine**
*Ref.: Ganong’s Physiology 23rd ed., Page-527*

8. When fully saturated, each gram of normal hemoglobin contains 1.39 mL of oxygen.
But blood normally contains small amount of inactive hemoglobin derivatives, and hence the measured value becomes 1.34 mL of oxygen.

**Ans. B: 1.33 ml O2**
*Ref.: Ganong’s Physiology 23rd ed., Page-610*

9. Serum has essentially the same composition as that of plasma except that its fibrinogen and clotting factors II, V and VIII has been removed and it has a higher serotonin content.

**Ans. C: Factor VII**
*Ref.: Ganong’s Physiology 23rd ed., Page-530*

10. **Hemophilia B** is also known as Christmas disease.
Hemophilia A is deficiency of factor VIII (classical hemophilia). It has sex-linked inheritance.

**Ans. A: IX**
*Ganong’s Physiology 23rd ed., Page-535*

11. **As AB blood group** doesn’t have any circulating agglutinins and can receive any type of blood group without developing a transfusion reaction due to ABO in compatibility, they are known as **universal recipient**.
Type O individuals are known as universal donor because they lack A and B antigens.

**Ans. D: AB**
*Ref.: Ganong’s Physiology 23rd ed., Page-528*
12. Factor X can be activated by reactions in either of two systems, an intrinsic and an extrinsic system.

The extrinsic system is triggered by the release of tissue thromboplastin, a protein–phospholipid mixture that activates factor VII. The tissue thromboplastin and factor VII activate factors IX and X. In the presence of PL, Ca\(^{2+}\), and factor V, activated factor X catalyzes the conversion of prothrombin to thrombin.

The extrinsic pathway is inhibited by a tissue factor pathway inhibitor that forms a quaternary structure with TPL, factor VIIa, and factor Xa.

Ans. B: Thromboplastin
Ref.: Ganong’s Physiology 23rd ed., Page 533

13. Hageman factor is factor XII, also known as glass factor.

The initial reaction in the intrinsic system is conversion of inactive factor XII to active factor XII (XIIa). This activation, which is catalyzed by high-molecular-weight kininogen and kallikrein, can be brought about in vitro by exposing the blood to electronegatively charged wettable surfaces such as glass and collagen fibers. Activation in vivo occurs when blood is exposed to the collagen fibers underlying the endothelium in the blood vessels. Active factor XII then activates factor XI, and active factor XI activates factor IX. Activated factor IX forms a complex with active factor VIII, which is activated when it is separated from von Willebrand factor. The complex of IXa and VIIIa activate factor X. Phospholipids from aggregated platelets (PL) and Ca\(^{2+}\) are necessary for full activation of factor X.

Ans. B: Intrinsic pathway
Ref.: Ganong’s Physiology 23rd ed., Page 532

14. In adults, about 85% of the erythropoietin comes from the kidneys and 15% from the liver. Both these organs contain the mRNA for erythropoietin. Erythropoietin can also be extracted from the spleen and salivary glands, but these tissues do not contain the mRNA and consequently do not appear to manufacture the hormone.

When renal mass is reduced in adults by renal disease or nephrectomy, the liver cannot compensate and anemia develops.

Erythropoietin is produced by interstitial cells in the peritubular capillary bed of the kidneys and by perivenous hepatocytes in the liver. It is also produced in the brain, where it exerts a protective effect against excitotoxic damage triggered by hypoxia; and in the uterus and oviducts, where it is induced by estrogen and appears to mediate estrogen-dependent angiogenesis.

Ans. A: Interstitial cells of kidney
Ref: Ganong’s Physiology 23rd ed., Page 677

15. The fluid portion of the blood, the plasma contains ions, inorganic molecules, and organic molecules.

The normal plasma volume is about 5% of body weight.

Plasma clots on standing, remaining fluid only if an anticoagulant is added. If whole blood is allowed to clot and the clot is removed, the remaining fluid is called serum.

Serum has essentially the same composition as plasma except that its fibrinogen and clotting factors II, V, and VIII have been removed and it has a higher serotonin content because of the breakdown of platelets during clotting.

Ans. D: 5% of Body Weight
Ref.: Ganong’s Physiology 23rd ed., Page 530
16. Anticlotting mechanisms:

Antithrombin III is a circulating protease inhibitor that binds to the serine proteases in the coagulation system, blocking their activity as clotting factors. This binding is facilitated by heparin, a naturally occurring anticoagulant that is a mixture of sulfated polysaccharides with molecular weights averaging 15,000–18,000. **The clotting factors that are inhibited are the active forms of factors IX, X, XI, and XII.**

The endothelium of the blood vessels also plays an active role in preventing the extension of clots into blood vessels. All endothelial cells except those in the cerebral microcirculation produce thrombomodulin, a thrombin-binding protein. In the circulating blood, thrombin is a procoagulant that activates factors V and VIII, but when it binds to thrombomodulin, it becomes an anticoagulant in that the thrombomodulin–thrombin complex activates protein C. Activated protein C (APC), along with its cofactor protein S, inactivates factors V and VIII and inactivates an inhibitor of tissue plasminogen activator, increasing the formation of plasmin.

**Ans. A: V**

*Ref.:* Ganong’s Physiology 23rd ed., Page-533

17. The capacity of tissues to regulate their own blood flow is referred to as **autoregulation.** Most vascular beds have an intrinsic capacity to compensate for moderate changes in perfusion pressure by changes in vascular resistance, so that blood flow remains relatively constant. This capacity is **well developed in the kidneys,** but it has also been observed in the mesentery, skeletal muscle, brain, liver, and myocardium.

   i. It is probably due in part to the intrinsic contractile response of smooth muscle to stretch (**myogenic theory of autoregulation**)

   ii. Vasodilator substances tend to accumulate in active tissues, and these “metabolites” also contribute to autoregulation (**metabolic theory of autoregulation**).

**Ans. D: All of the above**

*Ref.:* Ganong’s Physiology 23rd ed., Page-563

18. The membrane skeleton of RBC is made up in part of spectrin and is anchored to the transmembrane protein band 3 by the protein ankyrin. Band 3 is also an important anion exchanger.

The susceptibility of red cells to hemolysis is increased by deficiency of the enzyme glucose 6-phosphate dehydrogenase (G6PD), which catalyzes the initial step in the oxidation of glucose via the hexose monophosphate pathway. This pathway generates **NADPH,** which is needed for the maintenance of normal red cell fragility.

Hereditary spherocytosis is caused by abnormalities of the protein network that maintains the shape and flexibility of the red cell membrane.

**Ans. D: All of the above**

*Ref.:* Ganong’s Physiology 23rd ed., Page-525

19. **Bleeding Time** (Normal: 1-6 min.) is for checking the number of platelets. It is prolonged by lack of platelets.

**Clotting time** (Normal: 6-10 min.) varies widely depending upon the method employed, so discarded nowadays. Instead measurements of clotting factors are being done.

**aPTT/PTT** is employed for assessing intrinsic system.
Prothrombin time (Normal: 12 sec.) gives an good indication of concentration of prothrombin in the blood. **Extrinsic pathway is assessed.**

Ans. B: PT  
*Ref.: Guyton’s Physiology 11th ed., Page-467*

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20. **Reticulocytes** are immature RBCs, typically composing about 1% of the red cells in the human body.
Like mature red blood cells, reticulocytes do not have a cell nucleus.
They are called reticulocytes because of a reticular (mesh-like) network of ribosomal DNA
When there is an increased production of red blood cells to overcome **chronic or severe loss of mature red blood cells**, such as in haemolytic anemia, there is markedly high number and percentage of reticulocytes.
Abnormally low numbers of reticulocytes can be attributed to:
   i. Chemotherapy
   ii. Aplastic anemia
   iii. Pernicious anemia
   iv. Bone marrow malignancies
   v. Other causes of anaemia

**Ans. A: Chronic renal failure anemia**  
*Ref.: Harrison’s Medicine, 17th ed., p-359, 360*

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21. **Hereditary spherocytosis** (HS) is due to a deficiency of a protein called ankyrin.
Ankyrins are cell membrane proteins (thought to interconnect integral proteins with the **spectrin-based membrane skeleton**)
The ankyrin of red blood cells (erythrocytic ankyrin) is called ankyrin-R/ankyrin-1/ANK1.

**Ans. A: Spectrin**  
*Ref.: Robbin’s Pathology, 7th ed., p-625*

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22. The partial thromboplastin time (PTT) or activated partial thromboplastin time (aPTT/APTT) is a performance indicator measuring the efficacy of both the “intrinsic” (contact activation pathway) and the common coagulation pathways.
Apart from detecting abnormalities in blood clotting, it is also used to monitor the treatment effects with heparin, a major anticoagulant.

**Ans. D: Henoch – Schönlein purpura**  
*Ref.: Harrison’s Medicine, 17th ed., p-718*

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23. **In blood banks platelet concentrates are stored at 20° C to 24° C.**
In the peripheral circulation or in situations of hypothermia caused by trauma or extracorporeal circulation, platelets may encounter temperatures significantly lower than 37° C.
On the other hand, whole-body hyperthermia with an increase of the body core temperature to 41.8° C was reported in cancer treatment.
Therefore, a temperature range of 20°C to 42°C might be considered clinically relevant. However, the effects of hypo-and hyperthermia on platelets and platelet function are not well understood. It is well recognized that the exposure of platelets to 4°C results in platelet activation. Activation of chilled platelets (4°C) was observed as a morphological change from the resting discoid state.

**Ans. A:** 20 degree Celsius

*Ref.: Bailey & Love’s Surgery, 25th ed., p-21*

24. *Transferrin/siderophilin binds the iron in the lumen of GIT & most of the iron is transported bound to this globulin across the mucosal brush border*

**Transferrin**
- They are **iron-binding blood plasma glycoproteins** that control the level of free iron in biological fluids.
- In humans, it is encoded by the *TF* gene.
- Transferrin is a glycoprotein that binds iron very tightly but reversibly.
- Although iron bound to transferrin is less than 0.1% (4 mg) of the total body iron, it is the most important iron pool, with the highest rate of turnover.
- Transferrin has a molecular weight of around 80 kDa and contains 2 specific high-affinity Fe(III) binding sites.
- The affinity of transferrin for Fe(III) is extremely high but decreases progressively with decreasing pH below neutrality.
- When not bound to iron, it is known as "apo-transferrin"

**Ferritin**
- It is a ubiquitous intracellular protein that **stores iron** and releases it in a controlled fashion.
- The amount of ferritin stored reflects the amount of iron stored.
- In humans, it acts as a buffer against iron deficiency and iron overload.
- Ferritin is a globular protein complex consisting of 24 protein subunits and is the primary *intracellular iron-storage protein* in both prokaryotes and eukaryotes, keeping iron in a soluble and non-toxic form.
- Ferritin that is not combined with iron is called **apoferitin**.

**Ans. B:** Transferrin

*Ref.: Bailey & Love’s Surgery, 25th ed., p-21*

**CIRCULATORY SYSTEM**

25. *Central venous pressure denotes pressure in the great veins at their entrance into the right atrium and averages 4.6 mm Hg.*
- Pressure in larger veins outside thorax: 5.5 mm Hg
- Pressure in the venules: 12-18 mm Hg

**Ans. D:** Right atrium

*Ref.: Ganong’s Physiology, 23rd ed., p-549*

26. **Ans. A:** AV valves closure

*Ref.: Ganong’s Physiology, 23rd ed., p-512*
27. Cardiac Output (CO) = Stroke Volume × Heart Rate
   Normal SV is 70 mL and hence in a supine, resting man CO is 5.0 L/min. (70 mLX 72 beats/min.)
   Cardiac Index (CI) = CO / Body Surface Area (BSA) = SV × HR/BSA
   CI averages 3.2L
   
   Ans. B: Body surface area
   Ref.: Ganong’s Physiology, 23rd ed., p-514

28. QRS complex is due to ventricular depolarization and atrial repolarization.
   Normal duration is 0.08 sec.
   
   Ans. D: Ventricular depolarization
   Ref.: Ganong’s Physiology, 23rd ed., p-494

29. Vitamin K is involved in the carboxylation of certain glutamate residues in proteins to form gamma-carboxyglutamate residues (abbreviated Gla-residues). The modified residues are often (but not always) situated within specific protein domains called Gla domains, they play key roles in the regulation of:
   2. Bone metabolism: osteocalcin, also called bone Gla-protein (BGP)
   
   Ans. C: VIII
   Ref.: Guyton’s Physiology 11th ed., Page-862

30. Pulmonary arterial pressure is generated by the right ventricle ejecting blood into the pulmonary circulation, which acts as a resistance to the output from the right ventricle. With each ejection of blood during ventricular systole, the pulmonary artery blood volume increases, which stretches the wall of the artery. As the heart relaxes (ventricular diastole), blood continues to flow from the pulmonary artery into the pulmonary circulation. The smaller arteries and arterioles serve as the chief resistance vessels, and through changes in their diameter, regulate pulmonary vascular resistance.
   In hemodynamic terms, the mean pulmonary arterial pressure (PAP) can be described by
   \[ PAP = (CO \times PVR) + PVP \]
   Where CO = cardiac output, PVR = pulmonary vascular resistance, and PVP = pulmonary venous pressure.
   The PVP is essentially the same as left atrial pressure. Therefore, increases in CO, PVR or PVP will lead to increases in PAP. **Normaly, mean pulmonary artery pressure is about 15 mmHg**, and the pulmonary artery systolic and diastolic pressures about 25 and 10 mmHg, respectively. Pulmonary venous pressure is about 8 mmHg. Therefore, the pressure gradient driving flow through the pulmonary circulation is rather small at about 7 mmHg (mean pulmonary arterial minus venous pressures).
   
   Ans. B: 15 mm Hg
   Ref.: Ganong’s Physiology 23rd ed., p-592(fig.35-4)

31. The pressure in the aorta and in the brachial and other large arteries in a young adult human rises to a peak value (systolic pressure) of about 120 mm Hg during each heart cycle and falls to a minimum value (diastolic pressure) of about 70 mm Hg. The arterial pressure is conventionally written as systolic pressure over diastolic pressure e.g., 120/70 mm Hg.
The pulse pressure, the difference between the systolic and diastolic pressures, is normally about 50 mm Hg.

The mean pressure is the average pressure throughout the cardiac cycle. Because systole is shorter than diastole, the mean pressure is slightly less than the value halfway between systolic and diastolic pressure. It can actually be determined only by integrating the area of the pressure curve; however, as an approximation, mean pressure equals the diastolic pressure plus one third of the pulse pressure.

Ans. A: Diastolic pressure +1/3 (Systolic pressure- diastolic pressure)
Ref.: Ganong’s Physiology, 23rd ed.,p-544

32. The pressure inside the left ventricle is slightly higher than in the aorta during systole and hence blood flow in the vessels supplying the subendocardial portion of left ventricle occurs during diastole. On the other hand, the pressure difference between the right ventricle and aorta and the differential between the aorta and the right atria are somewhat greater during systole than during diastole so blood flow in these parts of the heart is not appreciably reduced during systole.

Ans. B: Diastole
Ref.: Ganong’s Physiology, 23rd ed.,p-578

33. The close relationship between coronary blood flow and myocardial O₂ consumption indicates that one or more of the products of metabolism cause coronary vasodilation. Factors suspected of playing this role include:
   - i. O₂ lack and increased local concentrations of CO₂
   - ii. H⁺,
   - iii. K⁺,
   - iv. Lactate,
   - v. Prostaglandins,
   - vi. Adenine nucleotides, and
   - vii. Adenosine.

Asphyxia, hypoxia, and intracoronary injections of cyanide all increase coronary blood flow 200–300% in denervated as well as intact hearts, and the feature common to these three stimuli is hypoxia of the myocardial fibers. A similar increase in flow is produced in the area supplied by a coronary artery if the artery is occluded and then released. This reactive hyperemia is similar to that seen in the skin. Evidence suggests that in the heart it is due to release of adenosine.

Ans. A: Adenosine
Ref.: Ganong’s Physiology, 23rd ed.,p-579,580

34. Conduction rate is 4 m/s in purkinje fibers whereas it is 1 m/s in ventricular muscles, atrial pathways and Bundle of His.
SA Node and AV Node has a conduction speed of 0.05 m/s

Ans. C: Have conduction velocity of four times than that of the heart muscle
Ref.: Ganong’s Physiology, 23rd ed.,p-492
35. Atrial pressure rises during atrial systole and continues to rise during isovolumetric ventricular contraction when the AV valves bulge into the atria. When the AV valves are pulled down by the contracting ventricular muscle, pressure falls rapidly and then rises as blood flows into the atria until the AV valves open early in diastole. The return of the AV valves to their relaxed position also contributes to this pressure rise by reducing atrial capacity. The atrial pressure changes are transmitted to the great veins, producing three characteristic positive waves in the record of jugular pressure. The a wave is due to atrial systole. As noted above, some blood regurgitates into the great veins when the atria contract, even though the orifices of the great veins are constricted. In addition, venous inflow stops, and the resultant rise in venous pressure contributes to the a wave. The c wave is the transmitted manifestation of the rise in atrial pressure produced by the bulging of the tricuspid valve into the atria during isovolumetric ventricular contraction. The v wave mirrors the rise in atrial pressure before the tricuspid valve opens during diastole. Venous pressure falls during inspiration as a result of the increased negative intrathoracic pressure and rises again during expiration. Careful bedside inspection of the pulsations of the jugular veins may give clinical information of some importance. For example
   i. in tricuspid insufficiency there is a giant c wave with each ventricular systole.
   ii. In complete heart block, when the atria and ventricles are beating at different rates, the a waves that are not synchronous with the radial pulse can be made out, and there is a giant a wave ("cannon wave") whenever the atria contract while the tricuspid valve is closed.

Ans. D: X wave
Ref.: Ganong’s Physiology, 23rd ed., p-512

36. Hypocalcemia causes prolongation of the ST segment and consequently of the QT interval, a change that is also produced by phenothiazines and tricyclic antidepressant drugs and by various diseases of the central nervous system. Increases in extracellular Ca\(^{2+}\) concentration enhance myocardial contractility. When large amounts of Ca\(^{2+}\) are infused into experimental animals, the heart relaxes less during diastole and eventually stops in systole (calcium rigor). However, in clinical conditions associated with hypercalcemia, the plasma calcium level is rarely if ever high enough to affect the heart.

Ans. B: Prolongation of ST segment
Ref.: Ganong’s Physiology, 23rd ed., p-504

37. Acute pulmonary edema is defined as the sudden increase in pulmonary capillary pressure (usually more than 20 mm Hg) as a result of acute and fulminant left ventricular failure. Patient appears extremely ill, poorly perfused, restless, sweaty, with an increased work of breathing and using respiratory accessory muscles, tachypneic, tachycardic, hypoxic and coughing with frothy sputum that on occasion is blood tinged. Patients with noncardiogenic pulmonary edema have a warm periphery, a bounding pulse, and an absence of S-3 gallop and jugular venous distention. Differentiation is often made based on PCWP measurements from invasive hemodynamic monitoring. PCWP is generally more than 20 mm Hg in HF and is less than 20 mm Hg in noncardiogenic pulmonary edema.

Ans. D: 20 mm Hg
Ref.: Ganong’s Physiology, 23rd ed., p-602
38. When a small blood vessel is transected or damaged, the injury initiates a series of events that lead to the formation of a clot. This seals off the damaged region & prevents further blood loss.
The initial event is constriction of the vessel.

**Physiological response to hemorrhage**
- It is a three-part process. The principal features are:
- Rapidly responding neural and humoral mechanisms direct available blood flow toward vital organs.
- More slowly evolving salt and water retention by the kidneys replaces the lost plasma.
- Erythropoiesis gradually replaces the lost red blood cells.

**Acute response to hemorrhage**
- The acute response includes a primary decrease in cardiac output, a secondary decrease in arterial pressure and **compensatory increases in heart rate** and vascular resistance.

**Autonomic involvement**
- Increased heart rate and **peripheral vasoconstriction** signal the autonomic nervous system's participation in the acute response to hemorrhage.
- Autonomic dysfunction decreases the body's tolerance to blood loss.

**Selective vasoconstriction**
- Sympathetic vasoconstriction during hemorrhage is selective.
- Many organs show intense vasoconstriction, while the cerebral and coronary circulations show little response to increased sympathetic outflow.
- The benefit of selectivity is that available blood flow, as meager as it may be, is preferentially directed to the brain and heart -- the vital organs.

**Support from Renin-Angiotensin system**
- The renin-angiotensin system supports arterial pressure in hemorrhage by constricting nonvital organs.
- This response is slower than the response of the sympathetic nervous system, but it is still an important part of the acute circulatory response to hemorrhage.

**Salt and water retention**
- After hemorrhage, with no intervention, salt and water retention over several days will increase blood volume to normal or above.
- Erythrocytes are replaced much more slowly.

**Ans. A: Vasoconstriction**
*Ref.:* Ganong’s Physiology, 23rd ed., p-531

39. **Preload is the degree to which the myocardium is stretched before it contracts**

**Preload**
- It is the end volumetric pressure that stretches the right or left ventricle of the heart to its greatest geometric dimensions under variable physiologic demand.
- Preload is theoretically most accurately described as the initial stretching of a single cardiomyocyte prior to contraction.
- The term end-diastolic volume is better suited to the clinic, although not exactly equivalent to the strict definition of preload.
- Atrial pressure is a surrogate for preload.
- Quantitatively, preload can be calculated as: \( \frac{LVEDP \times LVEDR}{2h} \)
• Where LVEDP = Left ventricular end diastolic pressure, LVEDR = Left ventricular end diastolic radius (at the ventricle’s midpoint), and h = thickness of the ventricle.
• This calculation is based on the Law of Laplace.
• **Preload is affected by venous blood pressure and the rate of venous return.**
  • These are affected by venous tone and volume of circulating blood.
  • Preload is related to the ventricular end-diastolic volume; a higher end-diastolic volume implies a higher preload.
• **Preload increases with exercise (slightly), increasing blood volume (over transfusion, polycythemia) and neuroendocrine excitement (sympathetic tone).**
• **An arteriovenous fistula can increase preload**

**Afterload**

• It is the tension or stress developed in the wall of the left ventricle during ejection.
• Following Laplace’s law, the tension upon the muscle fibers in the heart wall is the product of the pressure within the ventricle, multiplied by the volume within the ventricle, divided by the wall thickness.
• Therefore, a dilated left ventricle has a higher afterload.
• Conversely, a hypertrophied left ventricle has a lower afterload.
• When contractility becomes impaired and the ventricle dilates, the afterload rises and limits output.
• This may start a vicious circle, in which cardiac output is reduced as oxygen requirements are increased.
• Afterload can also be described as the pressure that the chambers of the heart must generate in order to eject blood out of the heart and thus is a consequence of the aortic pressure (for the left ventricle) and pulmonic pressure or pulmonary artery pressure (for the right ventricle).
• The pressure in the ventricles must be greater than the systemic and pulmonary pressure to open the aortic and pulmonic valves, respectively.
• As afterload increases, cardiac output decreases.

Preload best describes the maximum viscous blood volume of end diastole while afterload better describes the maximum tension of the myocardial muscle mass in end systole.

**Ans. B: Rest**

40. **Maximum coronary blood flow occurs during the phase of isovolumetric ventricular relaxation phase**

**Isovolumetric/ isometric relaxation time / IVRT**

• An interval in the cardiac cycle, from the aortic component of the second heart sound, that is, closure of the aortic valve, to onset of filling by opening of the mitral valve.
• Ventricular pressure decreases to zero rapidly while aortic pressure decreases only to 80 mm Hg i.e. it remains fairly high.
• Therefore, intra myocardial compression of blood vessels is minimal & perfusion pressure is maintained fairly high.
• So coronary blood flow rises sharply
• **Maximum coronary blood flow occurs during this phase**
• It can be used as an indicator of diastolic dysfunction.
• Prolonged IVRT indicates poor myocardial relaxation.
• A normal IVRT is about 70 ± 12 ms, and approximately 10ms longer in people over forty years.
• In abnormal relaxation, IVRT is usually in excess of 110ms.
• With restrictive ventricular filling, it is usually under 60 ms

**Ans. A: Isovolumic relaxation phase**
41. Isovolumetric ventricular relaxation phase begins after the closure of semilunar valves (aortic & pulmonary valves)

Cardiac Diastole
- It is the period of time when the heart relaxes after contraction in preparation for refilling with circulating blood.
- During ventricular diastole, the pressure in the (left and right) ventricles drops from the peak that it reaches in systole.
- When the pressure in the left ventricle drops to below the pressure in the left atrium, the mitral valve opens, and the left ventricle fills with blood that was accumulating in the left atrium.
- The isovolumic relaxation time (IVRT) is the interval from the aortic component of the second heart sound, that is, closure of the aortic valve, to onset of filling by opening of the mitral valve.
- Likewise, when the pressure in the right ventricle drops below that in the right atrium, the tricuspid valve opens, and the right ventricle fills with blood that was accumulating in the right atrium.
- During diastole the pressure within the right ventricle is lower than that in aorta, allowing blood to circulate in the heart itself via the coronary arteries.

Ans. C: Isovolumetric relaxation

ENDOCRINOLOGY

42. Anterior pituitary secretes six hormones:
   i. ACTH
   ii. TSH
   iii. GH
   iv. FSH
   v. LH
   vi. PRL
GnRH is secreted by hypothalamus

Ans. D: GnRH
Ref.: Ganong’s Physiology, 23rd ed., p-279

43. In hyperthyroidism:
   i. Total plasma T3, T4, RT3 is high
   ii. Free plasma T3, T4, RT3 is high
   iii. Plasma TSH is low
In hypothyroidism:
   i. Total plasma T3, T4, RT3 is low
   ii. Free plasma T3, T4, RT3 is low
   iii. Plasma TSH is high
Graves disease is most common cause of hyperthyroidism.

Ans. B: Euthyroid
Ref.: Ganong’s Physiology, 23rd ed., p-306

44. Two hormones serve as primary regulators of the calcium in blood: parathyroid hormone and calcitonin.
   Parathyroid hormone stimulates bones to release calcium into blood, digestive tract to absorb more calcium and kidneys to excrete less calcium and activate more vitamin D.
   Calcitonin slows the release of calcium from bones (inhibits resorption)
Other hormones which affects calcium metabolism are:

i. 1, 25-dihydroxycholecalciferol
ii. Glucocorticocoids
iii. Thyroid hormones
iv. Estrogens
v. Insulin

Causes of hypercalcemia include:

i. Overactivity of parathyroid glands: primary hyperparathyroidism
ii. Cancer: lung and breast cancer, multiple myeloma, paraneoplastic syndrome
iii. Metastasis to bones also increases risk of hypercalcemia.
iv. Other diseases: tuberculosis and sarcoidosis
v. Medications: lithium, Thiazide diuretics

Ans. None of the option
Ref. Ganong’s Physiology, 23rd ed., p-371

45. GH is synthesized and secreted from the anterior pituitary gland in a pulsatile manner throughout the day; surges of secretion occur at 3- to 5-hour intervals.

The largest and most predictable of these GH peaks occurs about 2 hours of deep sleep

Otherwise there is wide variation between days and individuals.

Ans. A: 2 hours after sleep
Ref.: Guyton’s Physiology, 11th ed., p-924

46. FBS in early morning is normally 80-90 mg/100 ml and 110 mg/100ml is considered to be the upper limit of normal.

Ans. A: 80-100 mg/100 ml
Ref.: Guyton’s Physiology, 11th ed., p-975

47. Oral GTT is done in fasting state.

Blood glucose values return back to below normal in non diabetics in about 2 hours whereas blood glucose in diabetics rises too much and levels fall back to control only after 4-6 hours.

Ans. A: Can be done in fasting as well as post prandial state
Ref.: Guyton’s Physiology, 11th ed., p-975

48. In oral glucose tolerance test, time taken for blood glucose level to fall back to control value is more important.

Blood glucose values return back to below normal in non diabetics in about 2 hours whereas blood glucose in diabetics fall back to control only after 4-6 hours and it fails to fall below the control level.

Control level is the value before the test was undertaken

Ans. B: Fasting blood sugar value more than 200 mg/100ml
Ref.: Guyton’s Physiology, 11th ed., p-975
49. **Ans. C: Calcitonin**  
*Ref.: Ganong’s Physiology, 23rd ed., p-370*

50. **Prolactin causes milk secretion** from the breast after estrogen and progesterone priming. Its effect on the breast involves increased action of mRNA and increased production of casein and lactalbumin. Prolactin also inhibits the effects of gonadotropins, possibly by an action at the level of the ovary. The function of prolactin in normal males is unsettled, but excess prolactin secreted by tumors causes impotence. Remember **oxytocin causes Ejection of milk**.

   **Ans. D: Prolactin**  
*Ref.: Ganong’s Physiology, 23rd ed., p-401*

51. Trace elements are defined as elements found in tissues in minute amounts. These are believed to be essential for life. In humans:
   i. Iron deficiency causes anemia
   ii. Cobalt is part of the vitamin B<sub>12</sub> molecule, and vitamin B<sub>12</sub> deficiency leads to megaloblastic anemia
   iii. Iodine deficiency causes thyroid disorders
   iv. Zinc deficiency causes skin ulcers, depressed immune responses, and hypogonadal dwarfism.
   v. Copper deficiency causes anemia and changes in ossification.
   vi. Chromium deficiency causes insulin resistance.
   vii. Fluorine deficiency increases the incidence of dental caries.

   **Ans. B: Zinc**  
*Ref.: Ganong’s Physiology, 23rd ed., p-464*

52. When plasma glucose is episodically elevated over time, small amounts of hemoglobin A are nonenzymatically glycated to form \( \text{HbA}_1c \). Careful control of the diabetes with insulin reduces the amount formed and consequently \( \text{HbA}_1c \) concentration is measured clinically as an integrated index of diabetic control for the 4- to 6-week period before the measurement.

   **Ans. D: HbA<sub>1c</sub>**  
*Ref.: Ganong’s Physiology, 23rd ed., p-323*

53. **Norepinephrine, epinephrine, and dopamine are secreted by the adrenal medulla.** Cats and some other species secrete mainly norepinephrine, but in dogs and humans, most of the catecholamine output in the adrenal vein is epinephrine. Norepinephrine also enters the circulation from noradrenergic nerve endings. **Glucocorticoids, Androgens and Mineralocorticoids are secreted by adrenal cortex.**

   **Ans. B: Catecholamines**  
*Ref.: Ganong’s Physiology, 23rd ed., p-338*

54. **Primary adrenal insufficiency** due to disease processes that destroy the adrenal cortex is called Addison’s disease. The condition used to be a relatively common complication of tuberculosis, and now it is usually due to autoimmune inflammation of the adrenal. Patients lose weight, are tired, and become chronically hypotensive. They have small hearts, probably because the hypotension decreases the work of the heart. Eventually they develop severe hypotension and shock (addisonian crisis).
This is due not only to mineralocorticoid deficiency but to glucocorticoid deficiency as well. Fasting causes fatal hypoglycemia, and any stress causes collapse. Water is retained, and there is always the danger of water intoxication. Circulating ACTH levels are elevated. The diffuse tanning of the skin and the spotty pigmentation characteristic of chronic glucocorticoid deficiency are due, at least in part, to the MSH activity of the ACTH in the blood. Minor menstrual abnormalities occur in women, but the deficiency of adrenal sex hormones usually has little effect in the presence of normal testes or ovaries.

Secondary adrenal insufficiency is caused by pituitary diseases that decrease ACTH secretion, and tertiary adrenal insufficiency is caused by hypothalamic disorders disrupting CRH secretion. Both are usually milder than primary adrenal insufficiency because electrolyte metabolism is affected to a lesser degree. In addition, there is no pigmentation because in both of these conditions, plasma ACTH is low, not high.

55. In diabetes, glucose piles up in the bloodstream, especially after meals. If a glucose load is given to a diabetic, the plasma glucose rises higher and returns to the baseline more slowly than it does in normal individuals. The response to a standard oral test dose of glucose, the oral glucose tolerance test, is used in the clinical diagnosis of diabetes. Impaired glucose tolerance in diabetes is due in part to reduced entry of glucose into cells (decreased peripheral utilization). In the absence of insulin, the entry of glucose into skeletal, cardiac, and smooth muscle and other tissues is decreased.

Intestinal absorption of glucose is unaffected, as is its reabsorption from the urine by the cells of the proximal tubules of the kidneys. Glucose uptake by most of the brain and the red blood cells is also normal.

Ans. B: Glucose load in fasting state, measurement of blood glucose after 2 hours
Ref.: Guyton’s Physiology, 11th ed., p-975

56. Free glucocorticoids inhibit ACTH secretion, and the degree of pituitary inhibition is proportionate to the circulating glucocorticoid level. The inhibitory effect is exerted at both the pituitary and the hypothalamic levels. The inhibition is due primarily to an action on DNA, and maximal inhibition takes several hours to develop, although more rapid “fast feedback” also occurs. The ACTH-inhibiting activity of the various steroids parallels their glucocorticoid potency. A drop in resting corticoid levels stimulates ACTH secretion, and in chronic adrenal insufficiency the rate of ACTH synthesis and secretion is markedly increased.

Thus, the rate of ACTH secretion is determined by two opposing forces: the sum of the neural and possibly other stimuli converging through the hypothalamus to increase ACTH secretion, and the magnitude of the braking action of glucocorticoids on ACTH secretion, which is proportionate to their level in the circulating blood.

Ans. B: ACTH
Ref.: Ganong’s Physiology, 23rd ed., p-354

57. Hyperthyroidism is characterized by nervousness; weight loss; hyperphagia; heat intolerance; increased pulse pressure; a fine tremor of the outstretched fingers; a warm, soft skin; sweating; and a BMR from +10 to as high as +100. It has various causes. However, the most common cause is Graves’ disease (Graves’ hyperthyroidism), which accounts for 60–80% of the cases. The condition, which for unknown reasons is much more common in women, is an autoimmune disease in which antibodies to the TSH receptor stimulate the receptor. This produces marked T4 and T3 secretion and enlargement of the thyroid gland (goiter). However, due to the feedback effects of T4 and T3, plasma TSH is low, not high.
Another hallmark of Graves’ disease is the occurrence of swelling of tissues in the orbits, producing protrusion of the eyeballs (exophthalmos). This occurs in 50% of patients and often precedes the development of obvious hyperthyroidism.

**Ans. D: Grave’s disease**  
*Ref.: Guyton’s Physiology, 11th ed., p-941*

58. PTH is essential for life. After parathyroidectomy, there is a steady decline in the plasma Ca\(^{2+}\) level. Signs of **neuromuscular hyperexcitability** appear, followed by full-blown **hypocalcemic tetany**.

In humans, tetany is most often due to inadvertent parathyroidectomy during thyroid surgery. Symptoms usually develop 2–3 days postoperatively but may not appear for several weeks or more. Injections of PTH correct the chemical abnormalities, and the symptoms disappear. Injections of Ca\(^{2+}\) salts give temporary relief.

The signs of tetany in humans include **Chvostek’s sign**, a quick contraction of the ipsilateral facial muscles elicited by tapping over the facial nerve at the angle of the jaw; and **Trousseau’s sign**, a spasm of the muscles of the upper extremity that causes flexion of the wrist and thumb with extension of the fingers.

**Ans. C: Raised calcium level**  
*Ref.: Ganong’s Physiology, 23rd ed., p-368*

59. Features of hypocalcemia:

i. Petechia which appear as one-off spots, then later become rashes.

ii. Perioral tingling and paraesthesia, ‘pins and needles’ sensation over the extremities of hands and feet. This is the earliest symptom of hypocalcaemia.

iii. **Tetany**, carpopedal spasm are seen.

iv. Trouseau sign of latent tetany (eliciting carpal spasm by inflating the blood pressure cuff and maintaining the cuff pressure above systolic)

v. Chvostek’s sign (tapping of the inferior portion of the zygoma will produce facial spasms)

vi. **Tendon reflexes are hyperactive**

vii. Life threatening complications

   a. Laryngospasm
   b. Cardiac arrhythmias

viii. ECG changes include:

   a. **Prolonged QT interval**
   b. Prolonged ST interval

**Ans. D: Tetany**  
*Ref.: Ganong’s Physiology, 22nd ed., p-382*

60. **Endocrine mechanisms which causes heat production (thermogenesis) are epinephrine, norepinephrine & thyroxine**

**Thermoregulatory response activated by exposure to cold (via posterior hypothalamus)**

- Increased heat production
  - Shivering
  - Hunger
  - Increased voluntary activity
  - Increased TSH secretion
  - Increased catecholamines
• Decreased heat loss
  o Cutaneous vasoconstriction
  o Curling up
  o Horripilation

T3 and T4 regulation
• The production of thyroxine and triiodothyronine is regulated by thyroid-stimulating hormone (TSH), released by the anterior pituitary.
• The thyroid and thyrotropes form a negative feedback loop: TSH production is suppressed when the T4 levels are high.
• The TSH production itself is modulated by thyrotropin-releasing hormone (TRH), which is produced by the hypothalamus and secreted at an increased rate in situations such as cold exposure (to stimulate thermogenesis).
• TSH production is blunted by somatostatin (SRIH), rising levels of glucocorticoids and sex hormones (estrogen and testosterone), and excessively high blood iodide concentration.

Ans. A: Increased Thyroxine release

61. Most of the stressful stimuli that increase ACTH secretion also activate the sympathetic nervous system
Alpha adrenergic stimulators (epinephrine & norepinephrine) inhibits insulin secretion
The condition in which sympathetic nervous system, including the sympatho-adrenal medullary system is activated are: fear, trauma, haemorrhage, fluid loss etc.
Stressful stimuli stimulates secretion of growth hormone in humans

Stress hormones
• They are cortisol, GH and norepinephrine
• They are released at periods of high stress.
• Stress hormones rise in the body during any neuroendocrine reaction such as surgery and they remain high as long as 72 hours, after which all these hormones return to their normal level, the last being cortisol.
• Stress hormones act by mobilizing energy from storage to muscles, increasing heart rate, blood pressure and breathing rate and shutting down metabolic processes such as digestion, reproduction, growth and immunity.

Stress response to surgery
• It is characterized by increased secretion of pituitary hormones and activation of the sympathetic nervous system.
• The changes in pituitary secretion have secondary effects on hormone secretion from target organs.
• For example, release of corticotrophin from the pituitary stimulates cortisol secretion from the adrenal cortex.
• Arginine vasopressin is secreted from the posterior pituitary and has effects on the kidney.
• In the pancreas, glucagon is released and insulin secretion may be diminished.
• The overall metabolic effect of the hormonal changes is increased catabolism which mobilizes substrates to provide energy sources, and a mechanism to retain salt and water and maintain fluid volume and cardiovascular homeostasis.

Ans. B: Increased insulin
Ref.: Ganong’s Physiology, 22nd ed., p-349, 370, 374; 23rd ed., p-326t, 341f, 350, 385t
EXCRETORY SYSTEM

62. When the mean systemic arterial pressure is 100 mm Hg,
   i. The glomerular capillary pressure is about 45 mm Hg.
   ii. The pressure in peritubular capillaries is about 8 mm Hg
   iii. The pressure in the renal vein is about 4 mm Hg

   Ans. D: 45
   Ref.: Ganong’s Physiology, 23rd ed., p-644

63. The descending part of the thin segment of the loop of Henle is highly permeable to water and moderately permeable to most solutes and little or no active reabsorption. The thick ascending limb of the loop of Henle reabsorbs about 25% of the filtered loads of sodium, chloride and potassium as well as large amount of calcium, bicarbonate and magnesium. It also secretes hydrogen ions into the tubular lumen

   Ans. B: Urea
   Ref.: Guyton’s Physiology, 11th ed., p-334

64. Normally about 65% of the filtered load of sodium and water, essentially all the filtered glucose and amino acids and a slightly lower percentage of filtered chloride are reabsorbed by the proximal tubule. The proximal tubules also secrete organic acids, bases and hydrogen ions into the tubular lumen

   Ans. A: PCT
   Ref.: Guyton’s Physiology, 11th ed., p-333

65. GFR = Kf \times \text{Net filtration pressure}
   Net filtration pressure represents the sum of the hydrostatic and colloid osmotic forces that either favour/oppose filtration across glomerular capillaries
   1. Hydrostatic pressure inside the glomerular capillaries (PGC) – Promotes filtration
   2. Hydrostatic pressure in the bowman’s capsule outside the capillaries (PB)-opposes filtration
   3. Colloid osmotic pressure of glomerular capillary plasma proteins-Opposes filtration
   4. Colloid osmotic pressure of Bowman’s capsule proteins-promotes filtration
      i. Afferent arteriolar constriction will reduce renal blood flow and reduce PGC, causing a reduction in GFR.
      ii. Efferent arteriolar constriction will reduce renal blood flow but increase PGC; these changes act in opposite directions with respect to GFR and the net effect on GFR is minimal.
      iii. A reduction in Kf will reduce GFR (contraction of mesangial cells and reducing the area available for filtration)
      iv. Any given vasoactive agent may have a spectrum of effects (on afferent/efferent arteriolar tone or Kf), making the net effect on GFR difficult to predict. Thus, angiotensin II, a major regulator of glomerular function, causes constriction of both afferent and efferent arterioles, as well as reducing Kf. The overall outcome for GFR depends on the relative magnitudes of these actions, which vary in different pathophysiological conditions.
      v. A high protein intake increase renal blood flow and GFR
      vi. Large increase in blood glucose levels in uncontrolled D increase renal blood flow and GFR.

   Kf: Glomerular ultrafiltration coefficient, PGC: mean hydrostatic pressure in glomerular capillaries

   Ans. C: Increased renal blood flow
   Ref.: Guyton’s Physiology, 11th ed., p-317
66. *Para*-Aminohippurate (PAH) is a substance used in the measurement of renal blood flow. It is useful in this measurement because it is primarily secreted by the renal tubules; only 20% is filtered by the glomerulus. The renal extraction ratio of PAH is a normal individual is approximately 0.92.

**Ans. B: PAH**  
*Ref.: Guyton’s Physiology, 11th ed., p-345*

67. Water reabsorption keeps pace with the sodium reabsorption in the proximal tubules and hence the concentration of sodium and total osmolarity remains the same.

**Ans. B: Bulk of water reabsorption occurs secondary to sodium absorption**  
*Ref.: Guyton’s Physiology, 11th ed., p-334*

68. Because one of its principal physiologic effects is the retention of water by the kidney, vasopressin is often called the antidiuretic hormone (ADH). It increases the permeability of the collecting ducts of the kidney, so that water enters the hypertonic interstitium of the renal pyramids. The urine becomes concentrated, and its volume decreases. The overall effect is therefore retention of water in excess of solute; consequently, the effective osmotic pressure of the body fluids is decreased. In the absence of vasopressin, the urine is hypotonic to plasma, urine volume is increased, and there is a net water loss. Consequently, the osmolality of the body fluid rises.

**Ans. D: Collecting ducts**  
*Ref.: Guyton’s Physiology, 11th ed., p-350*

69. The GFR in an average-sized normal man is approximately 125 mL/min. Its magnitude correlates fairly well with surface area, but values in women are 10% lower than those in men even after correction for surface area. A rate of 125 mL/min is 7.5 L/h, or 180 L/d, whereas the normal urine volume is about 1 L/d. Thus, 99% or more of the filtrate is normally reabsorbed. At the rate of 125 mL/min, the kidneys filter in 1 day an amount of fluid equal to 4 times the total body water, 15 times the ECF volume and 60 times the plasma volume.

**Ans. B: 125 ml/min**  
*Ref.: Guyton’s Physiology, 11th ed., p-316*

70. About 65% of the filtered electrolytes are absorbed in PCT actively  
Thin ascending loop of Henle: Passive diffusion of sodium  
Thick ascending loop of Henle: Active transportation of sodium  
Early distal tubule: Similar properties as that of thick ascending loop of Henle

**Ans. D: All of the above**  
*Ref.: Guyton’s Physiology, 11th ed., p-355*

71. Normally about 65% of the filtered load of sodium and water, essentially all the filtered glucose and amino acids and a slightly lower percentage of filtered chloride are reabsorbed by the proximal tubule.
The proximal tubules also secrete organic acids, bases and hydrogen ions into the tubular lumen.

**Ans. D: Hydrogen ions**  
*Ref.: Guyton’s Physiology, 11th ed., p-333*

72. **Glucose, amino acids, and bicarbonate are reabsorbed along with Na⁺ in the early portion of the proximal tubule.**  
Farther along the tubule, Na⁺ is reabsorbed with Cl⁻. Glucose is typical of substances removed from the urine by secondary active transport. It is filtered at a rate of approximately 100 mg/min (80 mg/dL of plasma x 125 mL/min). Essentially all of the glucose is reabsorbed, and no more than a few milligrams appear in the urine per 24 hours.

**Ans. A: PCT**  
*Ref.: Guyton’s Physiology, 11th ed., p-333*

73. **Angiotensin II acts at the PCT, Thick ascending loop of Henle/distal tubule, collecting tubule and leads to increased absorption of NaCl and water and increased H⁺ secretion.**  
ADH, Aldosterone and ANP acts at the collecting tubule and duct

**Ans. D: Angiotensin II**  
*Ref.: Guyton’s Physiology, 11th ed., p-342*

74. **ANP act on the collecting tubule and duct to increase Na⁺ excretion.**  
It produce this effect by dilating afferent arterioles and relaxing mesangial cells. Both of these actions increase glomerular filtration. In addition, it act on the renal tubules to inhibit Na⁺ reabsorption. Other actions include an increase in capillary permeability, leading to extravasation of fluid and a decline in blood pressure. In addition, it relax vascular smooth muscle in arterioles and venules. These peptides also inhibit renin secretion and counteract the pressor effects of catecholamines and angiotensin II.  
In the brain, ANP is present in neurons, and an ANP-containing neural pathway projects from the anteromedial part of the hypothalamus to the areas in the lower brainstem that are concerned with neural regulation of the cardiovascular system. In general, the effects of ANP in the brain are opposite to those of angiotensin II, and ANP-containing neural circuits appear to be involved in lowering blood pressure and promoting natriuresis.

**Ans. C: Collecting tubule**  
*Ref.: Guyton’s Physiology, 11th ed., p-342*

75. **Ans. B: Hypotension**  
*Ref.: Guyton’s Physiology, 11th ed., p-318*

76. i. The descending limb of the loop of Henle is permeable to H₂O, so H₂O diffuses out into the surrounding fluids. Because the loop is impermeable to Na⁺ and Cl⁻ and because these ions are not pumped out by active transport, Na⁺ and Cl⁻ remain inside the loop.

ii. As the fluid continues to travel down the descending limb of the loop, it becomes more and more concentrated, as water continues to diffuse out. Maximum concentration occurs at the bottom of the loop.

iii. The ascending limb of the loop of Henle is impermeable to water, but Na⁺ and Cl⁻ are pumped out into the surrounding fluids by active transport.

iv. As fluid travels up the ascending limb, it becomes less and less concentrated because Na⁺ and Cl⁻ are pumped out. At the top of the ascending limb, the fluid is only slightly less concentrated than at the top of the descending
limb. In other words, there is little change in the concentration of the fluid in the tubule as a result of traversing the loop of Henle.

v. In the fluid surrounding the loop of Henle, however, a gradient of salt (Na⁺, Cl⁻) is established, increasing in concentration from the top to the bottom of the loop.

vi. Fluid at the top of the collecting duct has a concentration of salts about equal to that at the beginning of the loop of Henle (some water is reabsorbed in the DCT).

vi. As the fluid descends the collecting duct, the fluid is exposed to the surrounding salt gradient established by the loop of Henle.

Two outcomes are possible:

a. If water conservation is necessary, as in **contraction of the extracellular fluid volume**, ADH stimulates the opening of water channels in the collecting duct, allowing H₂O to diffuse out of the duct and into the surrounding fluids. The result is **concentrated urine**.

b. If water conservation is not necessary, ADH is not secreted and the duct remains impermeable to H₂O. The result is **dilute urine**.

Ans. D: Contraction in extracellular fluid volume
Ref.: Guyton’s Physiology, 10th ed., p-315

77. **The JGA is composed of JG cells, macula densa cells & mesangial/Lacis cells**

**Juxtaglomerular apparatus**
- There are 3 different types of cells in the Juxtaglomerular Apparatus: Granular Cells/ juxtaglomerular cells, Macula Densa Cells and Mesangial Cells.

**Granular Cells/ juxtaglomerular cells**
- Granular cells are modified pericytes of glomerular arterioles.
- They are also known as Juxtaglomerular cells.
- The Juxtaglomerular cells secrete renin in response to:
  - Beta1 adrenergic stimulation
  - Decrease in renal perfusion pressure (detected directly by the granular cells)
  - Decrease in NaCl absorption in the Macula Densa (often due to a decrease in glomerular filtration rate, causing slower filtrate movement through the proximal tubule and thus more time for reabsorption. This results in a lower NaCl concentration by the time the filtrate reaches the Macula Densa).

**Macula Densa Cells**
- Macula densa cells are columnar epithelium thickening of the distal tubule.
- The macula densa senses sodium chloride concentration in the distal tubule of the kidney and secretes a locally active (paracrine) vasopressor which acts on the adjacent afferent arteriole to decrease glomerular filtration rate (GFR), as part of the tubuloglomerular feedback loop.
- Specifically, excessive filtration at the glomerulus or inadequate sodium uptake in the proximal tubule / thick ascending loop of Henle brings fluid to the distal convoluted tubule that has an abnormally high concentration of sodium.
- Na/Cl cotransporters move sodium into the cells of the macula densa.
- The macula densa cells do not have enough basolateral Na/K ATPases to excrete this added sodium, so the cell’s osmolarity increases.
- Water flows into the cell to bring the osmolarity back down, causing the cell to swell.
- When the cell swells, a stretch-activated non-selective anion channel is opened on the basolateral surface.
- ATP escapes through this channel and is subsequently converted to adenosine.
- Adenosine vasoconstricts the afferent arteriole via A1 receptors and vasodilates (to a lesser degree) efferent arterioles via A2 receptors which decreases GFR.
• Also, adenosine inhibits renin release in JG cells via A2 receptors on JG cells using Gi pathway.
• Also, when macula densa cells detect higher concentrations of Na and Cl they inhibit Nitric Oxide Synthetase (decreasing renin release).

**Mesangial cells/ Lacis cells**

• Mesangial cells are structural cells in the glomerulus that under normal conditions serve as anchors for the glomerular capillaries.
• The mesangial cells within the glomerulus communicate with mesangial cells outside the glomerulus (extraglomerular mesangial cells), and it is the latter cells that form part of the juxtaglomerular apparatus.
• These cells form a syncytium and are connected with glomerular mesangial cells via gap junctions.
• They contain actin and myosin, allowing them to contract when stimulated by renal sympathetic nerves, which may provide a way for the sympathetic nervous system to modulate the actions of the juxtaglomerular apparatus.

**Ans. B: Glomerulus**


### REPRODUCTIVE SYSTEM

78. **Aldosterone acts on the principal (P) cells of DCT and collecting tubules**

**Aldosterone**

• It increases the reabsorption of sodium ions and water and the secretion of potassium ions in the **collecting ducts** and **distal convoluted tubule** of the kidneys’ functional unit, the nephron.
• This increases blood volume and, therefore, increases blood pressure.
• Drugs that interfere with the secretion or action of aldosterone are in use as antihypertensives.
• One example is spironolactone, which lowers blood pressure by blocking the aldosterone receptor.
• Aldosterone is part of the renin-angiotensin system.
• Aldosterone is a yellow steroid hormone (mineralocorticoid family) produced by the outer-section (zona glomerulosa) of the adrenal cortex.
• The overall effect of aldosterone is to increase reabsorption of ions and water in the kidney. Its activity is reduced in Addison’s disease and increased in Conn’s syndrome.

**Ans. A: DCT**

*Ref.: AK Jain’s Physiology, 4th ed., p-745*

### GASTROINTESTINAL TRACT

79. **Faeces normally are about 3/4th water and 1/4th solid waste.**

**Solid water is composed of:**

i. About 30% dead bacteria
ii. 30% **undigested roughage** from the food and dried constituents of digestive juices.
iii. 10-20% fat
iv. 10-20% inorganic matter
v. 2-3% protein

**Ans. A: Undigested food**

*Ref.: Guyton’s Physiology, 11th ed., p-817*
80. **Secretion of bile by the liver parenchyma is stimulated by bile acids**
Secretion of watery solution of sodium and bicarbonate ion (component of bile) by secretory epithelial cells lining the ductules and ducts is stimulated by secretin.
Gall bladder contraction for gall bladder emptying is caused by Cholecystokinin.
Cholecystokinin is stimulated by fatty foods

**Ans. B: Bile acid**
*Ref.: Guyton’s Physiology, 11th ed., p-803*

81. **Only alcohol is absorbed from the stomach.**

**Ans. D: None**
*Ref.: Ganong’s Physiology, 23rd ed., p-452 (table 27-1)*

82. **The hepatocyte manufactures serum albumin, fibrinogen, and the prothrombin group of clotting factors (except for Factor 3,4)**
It is the main site for the synthesis of lipoproteins, ceruloplasmin, transferrin, complement, and glycoproteins
The liver forms fatty acids from carbohydrates and synthesizes triglycerides from fatty acids and glycerol.
Hepatocytes also synthesize apoproteins
It also synthesizes cholesterol from acetate and further synthesizes bile salts. The liver is the sole site of bile salts formation
**Remember the only major class of plasma proteins not synthesized by the liver are the immunoglobulins.**

**Ans. A: Gamma globulin**
*Ref.: Ganong’s Physiology, 23rd ed., p-482*

83. **Urobilinogen** is a colourless product of bilirubin reduction. It is **formed in the intestines** by bacterial action. Some urobilinogen is reabsorbed, taken up into the circulation and excreted by the kidney. This constitutes the normal “enterohepatic urobilinogen cycle”.
Urobilinogen content is determined by a reaction with Ehrlich’s reagent, which contains para-Dimethyl amino benzaldehyde and may be measured in **Ehrlich units**

**Ans. C: Intestine**
*Ref.: Ganong’s Physiology, 23rd ed., p-483*

84. **Trypsin** is secreted into the duodenum, where it hydrolyses peptides into its smaller building blocks, namely amino acids.
Trypsin catalyses the hydrolysis of peptide bonds.
Trypsins have an optimal operating pH of about 8.
Trypsins are considered endopeptidases, i.e., the cleavage occurs within the polypeptide chain rather than at the terminal amino acids located at the ends of polypeptides.
Trypsin is produced in the pancreas in the form of inactive trypsinogen.
It is then secreted into the small intestine, where the enzyme enteropeptidase activates it into trypsin by proteolytic cleavage. The resulting trypsins themselves activate more trypsinogens (autocatalysis), **chymotrypsinogen**, Elastase/proelastase, Carboxypeptidase A and B, Colipase and Phospholipase A2.

**Ans. A: Trypsin**
*Ref.: Ganong’s Physiology, 23rd ed., p-437 (table-26-2)*
85. **Glucose enters cells** by facilitated diffusion or, in the intestine and kidneys, by secondary active transport with Na⁺. In muscle, fat, and some other tissues, insulin facilitates glucose entry into cells by increasing the number of glucose transporters in the cell membranes.

The glucose transporters that are responsible for facilitated diffusion of glucose across cell membranes are a family of closely related proteins that cross the cell membrane 12 times and have their amino and carboxyl terminals inside the cell. They differ from and have no homology with the sodium-dependent glucose transporters, SGLT 1 and SGLT 2, responsible for the secondary active transport of glucose out of the intestine, although the SGLTs also have 12 transmembrane domains. Particularly in transmembrane helical segments 3, 5, 7, and 11, the amino acids of the facilitative transporters appear to surround channels that glucose can enter. Presumably, conformation then changes and glucose is released inside the cell.

**Ans. C: Na⁺**  
*Ref.*: Ganong’s Physiology, 23rd ed., p-453

86. Fat soluble vitamins (A,D,E,K) are poorly absorbed in the absence of bile/pancreatic lipase.

Malabsorption syndrome includes deficient absorption of amino acids, with marked body wasting and, eventually, hypoproteinemia and edema. Carbohydrate and fat absorption are also depressed. **Because of the defective fat absorption, the fat-soluble vitamins (vitamins A, D, E, and K) are not absorbed** in adequate amounts. The amount of fat and protein in the stools is increased, and the stools become bulky, pale, foul-smelling, and greasy (steatorrhea).

**Ans. D: All of the above**  
*Ref.*: Ganong’s Physiology, 23rd ed., p-458

87. In each hepatic lobule, the plates of hepatic cells are usually only one cell thick. Large gaps occur between the endothelial cells, and plasma is in intimate contact with the cells. Hepatic artery blood also enters the sinusoids. The central veins coalesce to form the hepatic veins, which drain into the inferior vena cava. Numerous macrophages (Kupffer cells) are anchored to the endothelium of the sinusoids and project into the lumen.

**Ans. C: Phagocytic cells**  
*Ref.*: Ganong’s Physiology, 23rd ed., p-480

88. In adults, the amount of iron lost from the body is relatively small. The losses are generally unregulated, and total body stores of iron are regulated by changes in the rate at which it is absorbed from the intestine.

Various dietary factors affect the availability of iron for absorption; for example, the phytic acid found in cereals reacts with iron to form insoluble compounds in the intestine. So do phosphates and oxalates. Most of the iron in the diet is in the ferric (Fe³⁺) form, whereas it is the ferrous (Fe²⁺) form that is absorbed. Fe³⁺ reductase activity is associated with the iron transporter in the brush borders of the enterocytes. **No more than a trace of iron is absorbed in the stomach,** but the gastric secretions dissolve the iron and permit it to form soluble complexes with ascorbic acid and other substances that aid its reduction to the Fe²⁺ form. The importance of this function in humans is indicated by the fact that iron deficiency anemia is a troublesome and relatively frequent complication of partial gastrectomy. **Almost all iron absorption occurs in the duodenum.** Some is stored in ferritin, and the remainder is transported out of the enterocytes by a basolateral transporter named ferroportin 1. A protein called hephaestin (Hp) is associated with ferroportin 1. It is not a transporter itself, but it facilitates basolateral transport.
In the plasma, $\text{Fe}^{2+}$ is converted to $\text{Fe}^{3+}$ and bound to the iron transport protein **transferrin**. This protein has two iron-binding sites. Normally, transferrin is about 35% saturated with iron.

Intestinal absorption of iron is regulated by three factors: recent dietary intake of iron, the state of the iron stores in the body, and the state of erythropoiesis in the bone marrow.

**Ans. D**: Decreases following gastrectomy  
*Ref.:* Ganong’s Physiology, 23rd ed., p-459

**89. Ans. A**: Active co-transport with sodium  
*Ref.:* Ganong’s Physiology, 23rd ed., p-453

**90. Causes of Vitamin B12 deficiency:**

a. **Inadequate Consumption**: Vitamin B$_{12}$ deficiency develops in people who do not consume any animal products (vegetarians) unless they take supplements.

b. **Inadequate Absorption**: The most common cause of vitamin B$_{12}$ deficiency is inadequate absorption.

   The following conditions can cause absorption to be inadequate:

   i. **Overgrowth of bacteria in part of the small intestine**
   
   ii. Malabsorption disorders
   
   iii. Inflammatory bowel disease
   
   iv. **Fish tapeworm infection**

   v. Surgery that removes the part of the small intestine where vitamin B$_{12}$ is absorbed

   vi. Drugs such as antacids and metformin

   vii. **Lack of intrinsic factor**—Intrinsic factor may be lacking because abnormal antibodies, produced by an overactive immune system, attack and destroy the parietal/oxyntic cells that produce intrinsic factor—an autoimmune reaction

   viii. Decreased stomach acidity

c. **Inadequate storage**: Liver disorders may interfere with the storage of vitamin B$_{12}$.

**Ans. D**: All of the above  
*Ref.:* Robbin’s Pathology, 7th ed., p-638

**91. Salivary Amylase** break large, insoluble starch molecules into soluble starches (amythrodextrin, acrodextrin and ultimately maltose.

Ptyalin acts on linear alpha (1,4) glycosidic linkages.

Optimum conditions for ptyalin

i. **Optimum pH** – 5.6 -6.9

ii. Human body temperature-37 degrees Celsius

iii. Presence of certain anions and activators:

   a. **Chlorine and bromine** – most effective

   b. Iodine – less effective

   c. Sulfate and phosphate – least effective

**Ans. B**: Chlorine Ion  
*Ref: Ganong’s Physiology, 23th ed., p-437 (Table 26.2)

**92. Iron-binding proteins** are carrier proteins and metalloproteins which play many important roles in metabolism. They bind Iron and can therefore inhibit microbial growth.

Two **iron-binding proteins** are lactoferrin and transferrin.
Some of the iron after absorption is stored in ferritin, and the remainder is transported out of the enterocytes by a transporter named ferroportin 1. Hephaestin is associated with ferroportin 1.

**Ans. C: Transferrin**
*Ref: Ganong’s Physiology, 23th ed., p-459*

93. The strength of the contractions of small intestine is proportional to the frequency of the spike generated by the slow waves. “Slow wave” amplitude is increased by GIT hormones released during digestion e.g. gastrin, CCK-PZ & motilin; whereas secretin and glucagon decrease the slow wave amplitude.

**Intestinal motility**
- Digestive hormones, cholecystokinin (CCK), gastrin and motilin increase intestinal motility
- **Secretin decreases the activity.**
- Serotonin and insulin can increase motility
- Glucagon can decrease motility.

**Secretin**
- Secretin is synthesized in cytoplasmic secretory granules of S-cells which are found mainly in mucosa of duodenum and smaller numbers in jejunum of small intestine
- Secretin is released into circulation and/or intestinal lumen in response to low duodenal pH.
- Also the secretion of secretin is increased by the products of protein digestion bathing the mucosa of the upper small intestine.
- It is the active form of prosecretin.
- This acidity is due to hydrochloric acid in the chyme that enters the duodenum from the stomach via the pyloric sphincter.
- Secretin targets the pancreas, which causes the organ to secrete a bicarbonate-rich fluid that flows into the intestine.
- Bicarbonate ion is a base that neutralizes the acid, thus establishing a pH favorable to the action of other digestive enzymes in the small intestine and preventing acid burns.
- Other factors are also involved in the release of secretin such as bile salts and fatty acids, which result in additional bicarbonates being added to the small intestine.
- Secretin release is inhibited by H2 receptor antagonists, which reduce gastric acid secretion.
- As a result, if the pH in the duodenum increases above 4.5, secretin cannot be released.
- Secretin increases water and bicarbonate secretion from duodenal Brunner’s glands in order to buffer the incoming protons of the acidic chyme.
- It also enhances the effects of cholecystokinin to induce the secretion of digestive enzymes and bile from pancreas and gallbladder, respectively.
- It counteracts blood glucose concentration spikes by triggering increased insulin release from pancreas, following oral glucose intake.
- Although secretin releases gastrin from gastrinomas, it inhibits gastrin release from the normal stomach.
- It reduces acid secretion from the stomach by inhibiting gastrin release from G cells.
- In addition, secretin stimulates pepsin secretion from chief cells.

**Ans. D: Secretin**
*Ref: Ganong’s Physiology, 22nd ed., p-480-491; AK Jain’s Physiology, 4th ed., p-252*

94. Food in the stomach increase gastric acid secretion by stretching the receptors in the wall of the stomach (mechanical stimulus). The fibers from the receptor enter Meissner’s plexus (site of ganglion cells of vagus nerve).
Physiology

Products of digestion (specially amino acids) in the stomach also stimulates gastric mucosa (chemical stimulus)

Gastric secretion

Gastric acid is produced by parietal cells (also called oxyntic cells) in the stomach. There are three phases in the secretion of gastric acid:

- The cephalic phase: Thirty percent of the total gastric acid secretions to be produced is stimulated by anticipation of eating and the smell or taste of food
- The gastric phase: Sixty percent of the acid secreted is stimulated by the distention of the stomach with food. Plus, digestion produces proteins, which causes even more gastrin production
- The intestinal phase: The remaining 10% of acid is secreted when chyme enters the small intestine, and is stimulated by small intestine distention.

Regulation of secretion

- Gastric acid production is regulated by both the autonomic nervous system and several hormones.
- The parasympathetic nervous system, via the vagus nerve, and the hormone gastrin stimulate the parietal cell to produce gastric acid, both directly acting on parietal cells and indirectly, through the stimulation of the secretion of the hormone histamine from enterochromaffine-like cells (ECL).
- Vasoactive intestinal peptide, cholecystokinin, and secretin all inhibit production.
- The production of gastric acid in the stomach is tightly regulated by positive regulators and negative feedback mechanisms.
- Four types of cells are involved in this process: parietal cells, G cells, D cells and enterochromaffine-like cells.
- Besides this, the endings of the vagus nerve (CN X) and the intramural nervous plexus in the digestive tract influence the secretion significantly.
- Nerve endings in the stomach secrete two stimulatory neurotransmitters: acetylcholine and gastrin-releasing peptide. Their action is both direct on parietal cells and mediated through the secretion of gastrin from G cells and histamine from enterochromaffine-like cells.
- Gastrin acts on parietal cells directly and indirectly too, by stimulating the release of histamine.
- The release of histamine is the most important positive regulation mechanism of the secretion of gastric acid in the stomach.

Its release is stimulated by gastrin and acetylcholine and inhibited by somatostatin.

Ans. D: Low gastric pH


NERVOUS SYSTEM

95. Retina is organized in 10 layers and contains rods and cones, which are the visual receptors, plus four types of neurons:
   i. Bipolar cells
   ii. Ganglion cells
   iii. Horizontal cells
   iv. Amacrine cells

Ans. B: Retina

Ref.: Ganong’s Physiology, 23rd ed., p-182

96. Anterolateral system carries:
   i. Pain
   ii. Thermal sensations
iii. Crude touch and pressure sensations capable only of crude ability on the surface of the body
iv. Tickle and itch sensations
v. Sexual sensations

**Proprioception is carried in dorsal column-medial lemniscal system**

**Ans. A: Proprioception**
*Ref.: Guyton’s Physiology, 11th ed., p-588*

97. Once threshold intensity is reached, a full fledged action potential is produced. The action potential fails to occur if the stimulus is subthreshold in magnitude and it occurs with constant amplitude and form, regardless of the strength of the stimulus if the stimulus is at or above threshold intensity. Therefore **action-potential obeys all or none law**

**Ans. C: Action potential**
*Ref.: Ganong’s Physiology, 23rd ed., p-85*

98. **Alpha fibers** are the thickest (fiber diameter of 12-20 micrometer) and **fastest conduction velocity** (of 70-120 m/s) whereas **C-fibers** are the thinnest (fiber diameter of 0.3-1.2 micrometer) and **slowest conduction velocity** (of 0.5-2 m/s)

**Ans. A: C-fiber**
*Ref.: Ganong’s Physiology, 23rd ed., p-89*

99. The primary colors normally are red, green, and blue. Because white colour, spectral colour or even extraspectral colour can be produced after mixing them in various proportions.

**Ans. D: White**
*Ref.: Ganong’s Physiology, 23rd ed., p-196*

100. **Colour blindness is inherited as recessive and X-linked characteristics.**
The prefixes “Prot-” “Deuter-” and “Trit-” stands for defects of Red, Green and Blue cone systems. So **tritanopia (Rarest) has Defect of blue colour.**

Trichromats are normal individuals.

**Ans. D: Defect in 1 or more prime colours**
*Ref.: Ganong’s Physiology, 23rd ed., p-196*

101. 3 semicircular canals in each vestibular apparatus known as anterior, posterior and lateral (horizontal) semicircular canals.

They are arranged at right angles to each other.

They are filled with endolymph

Base of cupula is in close contact with afferent fibers of vestibular division of the eight cranial nerve

**Ans. C: Arranged at right angles to each other**
*Ref.: Ganong’s Physiology, 23rd ed., p-206*
102. **Blind spot/physiological blind spot, punctum caecum** is the place in the visual field that corresponds to the lack of light-detecting photoreceptor cells on the **optic disc of the retina** where the optic nerve passes through it. The **ora serrata** is the serrated junction between the retina and the ciliary body. This junction marks the transition from the simple non-photosensitive area of the retina to the complex, multi-layered photosensitive region.

   **Ans. B: Optic disc**
   **Ref.:** Ganong’s Physiology, 23rd ed., p-182

103. The smooth muscle of the bladder (detrusor) is innervated by sympathetic nervous system fibers (from the lumbar spinal cord) and parasympathetic fibers (from the sacral spinal cord).
Fibers in the pelvic nerves are the afferent limb of the voiding reflex, and the parasympathetic fibers to the bladder that constitutes the efferent limb also travel in these nerves.
**The reflex is integrated in the sacral portion of the spinal cord.**
   Muscle bundles pass on either side of the urethra called the internal urethral sphincter.
   Farther along the urethra is a sphincter of skeletal muscle called external urethral sphincter.
   When the individual is ready to urinate, he or she consciously initiates voiding, causing the bladder to contract and the outlet to relax.
   During the storage phase the internal urethral sphincter remains tense and the detrusor muscle relaxed by sympathetic stimulation.
   During micturition, parasympathetic stimulation causes the detrusor muscle to contract and the internal urethral sphincter to relax. The external urethral sphincter (sphincter urethrae) is under somatic control and is consciously relaxed during micturition.
   Once the voluntary signal to begin voiding has been issued, neurons in pontine micturition center fire maximally, causing excitation of sacral preganglionic neurons. The firing of these neurons causes the wall of the bladder to contract; as a result, a sudden, sharp rise in pressure in intravesical pressure occurs.
   When the external urinary sphincter is relaxed urine flows from the urinary bladder when the pressure there is great enough to force urine to flow through the urethra.
   When the sacral dorsal roots are interrupted by diseases of the dorsal roots such as tabes dorsalis in humans, all reflex contractions of the bladder are abolished. The bladder becomes distended, thin-walled, and hypotonic.
   When the afferent and efferent nerves are both destroyed, as they may be by tumors of the cauda equina or filum terminale, the bladder is flaccid and distended for a while. Gradually, however, the muscle of the “decentralized bladder” becomes active. The bladder becomes shrunken and the bladder wall hypertrophied.
   During spinal shock, the bladder is flaccid and unresponsive. It becomes overfilled, and urine dribbles through the sphincters (overflow incontinence).
   After spinal shock has passed, the voiding reflex returns, although there is, of course, no voluntary control and no inhibition or facilitation from higher centers when the spinal cord is transected. Bladder capacity is reduced, and the wall becomes hypertrophied. This type of bladder is sometimes called the spastic neurogenic bladder.

   **Ans. A: Sacral portion of spinal cord**
   **Ref.:** Ganong’s Physiology, 23rd ed., p-662

104. **Ans. B: Planning and programming of voluntary movements**
   **Ref.:** Ganong’s Physiology, 23rd ed., p-257

105. **Spatial orientation is dependent on inputs from vestibular receptors, visual cues, proprioceptors in joint capsules and cutaneous touch and pressure receptors.**

   **Ans. D: All of the above**
   **Ref.:** Ganong’s Physiology, 23rd ed., p-216
106. The Pyramidal Tract/ corticospinal tract is group of fibers carries messages for voluntary motor movement to the lower motor neurons in the brain stem and spinal cord.

Approximately 80% of the cell bodies of the pyramidal tract are located on the precentral gyrus of the frontal lobe (the motor strip). Approximately 20% of the pyramidal tract fibers also originate in the postcentral gyrus of the parietal lobe, in Brodmann’s areas 1, 2, and 3. Regardless of the location of their cell bodies, pyramidal tract fibers begin their descent from the cortex as a corona radiata (radiating crown) before forming the internal capsule.

This tract is direct and monosynaptic which allows messages to be transmitted very rapidly from the central nervous system to the periphery.

The fibers of the pyramidal tract that synapse with spinal nerves sending information about voluntary movement to the skeletal muscles form the cortico-spinal tract. As they descend through the brain, they form part of the posterior limb of the internal capsule.

At the pyramids in the inferior part of the medulla, eighty-five to ninety percent of cortico-spinal fibers decussate, or cross to the other side of the brain. The remaining ten to fifteen percent continue to descend ipsilaterally. The fibers that decussate are called the lateral cortico-spinal tract or the lateral pyramidal tract. Because they descend along the sides of the spinal cord, the uncrossed or direct fibers that synapse with spinal nerves on the ipsilateral side of the body are called the direct pyramidal tract. They may also be referred to as the ventral pyramidal tract or the anterior cortico-spinal tract since they travel down the ventral aspect of the spinal cord.

The spinal nerves receive only contralateral innervation from the cortico-spinal tract. This means that unilateral pyramidal tract lesions above the point of decussation in the pyramids will cause paralysis of the muscles served by the spinal nerves on the opposite side of the body. For example, a lesion on the left pyramidal tract above the point of decussation could cause paralysis on the right side of the body.

Ans. A: Paralysis of the opposite half of the body
Ref.: Ganong’s Physiology, 23rd ed., p-244

107. Fasciculus gracilis and fasciculus cuneatus lies in the dorsal column.

It is part of an ascending pathway that is important for well-localized fine touch and conscious proprioception called the posterior column-medial lemniscus pathway.

Joint capsules, tactile and pressure receptors send a signal through the dorsal root ganglia up through the fasciculus gracilis for lower body sensory impulses and the fasciculus cuneatus for upper body impulses. Once the fasciculus gracilis reaches the nucleus gracilis and the fasciculus cuneatus reaches the nucleus cuneatus in the lower medulla, they begin to cross over the medulla as the internal arcuate fibers. When they reach the contralateral side, they become the medial lemniscus, which is the second part of the posterior column-medial lemniscus pathway.

Lesions in this pathway can diminish or completely abolish tactile sensations and movement or position sense below the lesion

Ans. A: Fasciculus gracilis
Ref.: Ganong’s Physiology, 23rd ed., p-174

108. No matter where a particular sensory pathway is stimulated along its course to the cortex, the conscious sensation produced is referred to the location of the receptor. This principle is called the law of projection.

i. Cortical stimulation experiments during neurosurgical procedures on conscious patients illustrate this phenomenon. For example, when the cortical receiving area for impulses from the left hand is stimulated, the patient reports sensation in the left hand, not in the head.
Another example is seen in amputees. Some of these patients may complain, often bitterly, of pain and proprioceptive sensations in the absent limb (phantom limb). The ends of the nerves cut at the time of amputation often form nerve tangles called neuromas. These may discharge spontaneously or when pressure is put on them. The impulses generated in them are in nerve fibers that previously came from sense organs in the amputated limb, and the sensations evoked are projected to where the receptors used to be.

Answer B: Law of projection
Ref.: Ganong’s Physiology, 23rd ed., p-155, 176

109. When the muscles are hypertonic, the sequence of moderate stretch muscle contraction, strong stretch muscle relaxation is clearly seen. Passive flexion of the elbow, for example, meets immediate resistance as a result of the stretch reflex in the triceps muscle. Further stretch activates the inverse stretch reflex. The resistance to flexion suddenly collapses, and the arm flexes. Continued passive flexion stretches the muscle again, and the sequence may be repeated. This sequence of resistance followed by give when a limb is moved passively is known as the clasp-knife effect because of its resemblance to the closing of a pocket knife. It is also known as the lengthening reaction because it is the response of a spastic muscle to lengthening.

Answer A: Inverse stretch reflex and C: Lengthening reaction
Ref.: Ganong’s Physiology, 23rd ed., p-163

110. Parkinson’s disease has both hypokinetic and hyperkinetic features. In this condition, which was originally described by James Parkinson and is named for him, the nigrostriatal dopaminergic neurons degenerate. The fibers to the putamen are most severely affected.

Dopaminergic neurons and dopamine receptors are steadily lost with age in the basal ganglia in normal individuals, and an acceleration of these losses apparently precipitates parkinsonism. Symptoms appear when 60–80% of the nigrostriatal dopaminergic neurons are lost. Parkinsonism is also seen as a complication of treatment with the phenothiazine group of tranquilizer drugs and other drugs that block D₂ dopamine receptors.

Answer A: Dopamine
Ref.: Ganong’s Physiology, 23rd ed., p-253

111. From a functional point of view, the cerebellum is divided into three parts:
   i. The nodulus in the vermis and the flanking flocculus in the hemisphere on each side form the flocculonodular lobe, or vestibulocerebellum. This lobe, which is phylogenetically the oldest part of the cerebellum, has vestibular connections and is concerned with equilibrium.
   ii. The rest of the vermis and the adjacent medial portions of the hemispheres form the spinocerebellum, the region that receives proprioceptive input from the body as well as a copy of the “motor plan” from the motor cortex. By comparing plan with performance, it smooths and coordinates movements that are ongoing. The vermis projects to the brainstem area concerned with control of axial and proximal limb muscles, whereas the hemispheres project the brainstem areas concerned with control of distal limb muscles.
   iii. The lateral portions of the cerebellar hemispheres are called the cerebrocerebellum, or neocerebellum. They are the newest from a phylogenetic point of view, reaching their greatest development in humans. They interact with the motor cortex in planning and programming movements.

Answer B: Equilibrium
Ref.: Ganong’s Physiology, 23rd ed., p-257
112. The term limbic lobe, or limbic system, is applied to the part of the brain that consists of a rim of cortical tissue around the hilum of the cerebral hemisphere and a group of associated deep structures—the amygdala, the hippocampus, and the septal nuclei. The region was formerly called the rhinencephalon because of its relation to olfaction, but only a small part of it is actually concerned with smell.

Ans. D: Planned motor activity
Ref.: Guyton’s Physiology, 11th ed., p-732, 736

113. Ans. B: Awake state
Ref.: Ganong’s Physiology, 23rd ed., p-233

114. The axons of the ganglion cells pass caudally in the optic nerve and optic tract to end in the lateral geniculate body, a part of the thalamus. The fibers from each nasal hemiretina decussate in the optic chiasm. In the geniculate body, the fibers from the nasal half of one retina and the temporal half of the other synapse on the cells whose axons form the geniculocalcarine tract. This tract passes to the occipital lobe of the cerebral cortex.

The primary visual receiving area (primary visual cortex, Brodmann’s area 17; also known as V1), is located principally on the sides of the calcarine fissure.

Activation occurs not only in the occipital lobe but also in parts of the inferior temporal cortex, the postero-inferior parietal cortex, portions of the frontal lobe, and the amygdala. The subcortical structures activated in addition to the lateral geniculate body include the superior colliculus, pulvinar, caudate nucleus, putamen, and claustrum.

Ans. D: Its the only area in the brain activated by visual stimuli
Ref.: Ganong’s Physiology, 23rd ed., p-184, 194

115. Humans aroused at a time when they show the EEG characteristics of REM sleep generally report that they were dreaming, whereas individuals awakened from slow-wave sleep/NREM do not. This observation and other evidence indicate that REM sleep and dreaming are closely associated. The tooth-grinding (bruxism) that occurs in some individuals is also associated with dreaming.

Ans. A: REM
Ref.: Ganong’s Physiology, 23rd ed., p-235

116. There is no single wavelength corresponding to white colour.

Perception of white can be achieved by equally stimulating the red, green and blue cones.

Ans. D: Stimulation of red, blue and green cones equally
Ref.: Guyton’s Physiology, 11th ed., p-633

117. Glial cells are very numerous, there are 10–50 times as many glial cells as neurons. The Schwann cells that invest axons in peripheral nerves are classified as glia. In the CNS, there are three main types of neuroglia:

i. **Microglia** consists of scavenger cells that resemble tissue macrophages. They probably come from the bone marrow and enter the nervous system from the circulating blood vessels.

ii. **Oligodendrocytes** are involved in myelin formation.

iii. **Astrocytes**, which are found throughout the brain, are of two subtypes. Fibrous astrocytes, which contain many intermediate filaments, are found primarily in white matter. Protoplasmic astrocytes are found in gray matter and have granular cytoplasm. Both types send processes to blood vessels, where they induce capillaries to form the
tight junctions that form the blood–brain barrier. They also send processes that envelop synapses and the surface of nerve cells. They have a membrane potential that varies with the external K⁺ concentration but do not generate propagated potentials. They produce substances that are tropic to neurons, and they help maintain the appropriate concentration of ions and neurotransmitters by taking up K⁺ and the neurotransmitters glutamate and α-aminobutyrate.

**Ans. D: Kupffer cells**  
*Ref.:* Ganong’s Physiology, 23rd ed., p-80

118. Into the cupula are projected hundreds of cilia from hair cells located on the ampullary crest.

When the head suddenly begins to rotate in any direction (angular acceleration); the endolymph in the semicircular canals, because of its inertia, tend to remain stationary while the semicircular canals turn. This cause relative fluid flow in the ducts in the direction opposite to the head rotation.

Similarly **When the rotation stops suddenly: the endolymph continues to rotate. And this time cupula bends in opposite direction**, causing hair cells to stop discharging entirely.

**Ans. C: It moves when perilymph moves**  
*Ref.:* Guyton’s Physiology, 11th ed., p-695

119. The eye is unique in that the receptor potential of the photoreceptors and the electrical responses of most of the other neural elements in the retina are local, graded potentials and it is only in ganglion cells that all or none action potentials are generated.

**The response of rods, cones and horizontal cells are hyperpolarizing.**

Response of bipolar cells are either hyperpolarizing/depolarizing

Amacrine cells produces depolarizing potentials and spikes.

**Ans. A: Hyperpolarisation occurs**  
*Ref.:* Ganong’s Physiology, 23rd ed., p-190

120. In a myelinated neuron, number of sodium channels per square micrometer is:

i. Cell body-50-75  
ii. Axon terminal-20-75  
iii. Surface of myelin-Less than 25  
iv. **Nodes of Ranvier-2000-12,000**  
v. In the initial segment:350-500

In unmyelinated neurons, number is about 110

**Ans. D: Nodes of Ranvier**  
*Ref.:* Ganong’s Physiology, 23rd ed., p-85

121. The neurons that are **cholinergic**:

i. All preganglionic neurons  
ii. All parasympathetic postganglionic neurons  
iii. **Sympathetic postganglionic neurons innervating sweat glands.**
iv. Sympathetic postganglionic neurons innervating blood vessels in some skeletal muscles and produces vasodilation when stimulated

Ans. A: Cholinergic mediated sympathetic activity
Ref.: Ganong’s Physiology, 23rd ed., p-266

122. When the muscle spindle is stretched, its sensory endings are distorted and receptor potentials are generated. These in turn set up action potentials in the sensory fibers at a frequency proportionate to the degree of stretching. The spindle is in parallel with the extrafusal fibers, and when the muscle is passively stretched, the spindles are also stretched. This initiates reflex contraction of the extrafusal fibers in the muscle. On the other hand, the spindle afferents characteristically stop firing when the muscle is made to contract by electrical stimulation of the nerve fibers to the extrafusal fibers because the muscle shortens while the spindle does not.

Muscle spindle and its reflex connections operates to maintain muscle length

Ans. C: Feedback device to maintain muscle length
Ref.: Ganong’s Physiology, 23rd ed., p-160

123. Sensory organs and their responses:
   i. Meissner corpuscles-Responds to changes in texture and slow vibrations
   ii. Merkel cells-responds to sustained pressure and touch
   iii. Ruffini corpuscles-respond to sustained pressure
   iv. Pacian corpuscles-respond to deep pressure and fast vibration

Ans. A: Meissner corpuscles
Ref.: Ganong’s Physiology, 23rd ed., p-150

124. Myasthenia gravis is a serious and sometimes fatal disease in which skeletal muscles are weak and tire easily. It is caused by the formation of circulating antibodies to the muscle type of nicotinic acetylcholine receptors. These antibodies destroy some of the receptors and bind others to neighboring receptors, triggering their removal by endocytosis. The reason for the development of autoimmunity to acetylcholine receptors in this disease is still unknown.
Another condition that resembles myasthenia gravis is Lambert-Eaton syndrome. In this condition, muscle weakness is caused by antibodies against one of the Ca$^{2+}$ channels in the nerve endings at the neuromuscular junction. This decreases the normal Ca$^{2+}$ influx that causes acetylcholine release. However, muscle strength increases with prolonged contractions as more Ca$^{2+}$ is released.

Ans. D: Myasthenia gravis
Ref.: Ganong’s Physiology, 23rd ed., p-126

125. Effects of parasympathetic activity:
   a. Contraction:
      i. Ciliary muscle, Sphincter muscle of iris
      ii. Bronchial muscle
      iii. Gall bladder
      iv. Detrusor muscle of bladder
b. Relaxation:
   i. Sphincters of stomach, intestines and bladder

c. Decreases:
   i. Heart rate, Contractility and conduction velocity

d. Increases:
   i. Motility of stomach and intestines
   ii. Secretion of exocrine pancreas, salivary glands and lacrimal gland

**Ans. A: Tachycardia**
*Ref.: Ganong’s Physiology, 23rd ed., p-267 (Table 17-1)*

126. **Ans. D: Seen in REM sleep**
*Ref.: Ganong’s Physiology, 23rd ed., p-233*

127. Melatonin and the enzymes responsible for its synthesis from serotonin by N-acetylation and O-methylation are present in pineal parenchymal cells, and the hormone is secreted by them into the blood and the cerebrospinal fluid.

Melatonin synthesis and secretion are increased during the dark period of the day and maintained at a low level during the daylight hours. This remarkable diurnal variation in secretion is brought about by norepinephrine secreted by the postganglionic sympathetic nerves (nervi conarii) that innervate the pineal. The norepinephrine acts via -adrenergic receptors in the pineal to increase intracellular cAMP, and the cAMP in turn produces a marked increase in N-acetyltransferase activity. This results in increased melatonin synthesis and secretion.

**Effects of Melatonin:**
   i. It plays a role in sleep mechanism
   ii. It is supposed to decrease gonadotropin hormone secretion by anterior pituitary

**Vomiting centre is located in the brain stem.** From here, motor impulses that cause the actual vomiting are transmitted from the vomiting center by the way of the 5th, 7th, 9th, 10th and 12th cranial nerves to the upper GIT, through vagal and sympathetic nerves to the lower tract and through spinal nerves to the diaphragm and abdominal vessels.

**Ans. A: Vomiting**

128. **Ans. D: Bronchial musculature relaxation**
*Ref.: Ganong’s Physiology, 23rd ed., p-267, 268*

129. Despite their name, some neurotransmitters inhibit the transmission of nerve impulses. They do this by opening
   i. Chloride channels and/or
   ii. Potassium channels in the plasma membrane.

In each case, opening of the channels increases the membrane potential by
   i. Letting negatively-charged chloride ions (Cl\(^-\)) in and
   ii. Positively-charged potassium ions (K\(^+\)) out

This hyperpolarization is called an inhibitory postsynaptic potential (IPSP).

Although the threshold voltage of the cell is unchanged, it now requires a stronger excitatory stimulus to reach threshold.
Example: Gamma amino butyric acid (GABA). This neurotransmitter is found in the brain and inhibits nerve transmission by both mechanisms:

i. Binding to \( \text{GABA}_A \) receptors opens chloride channels in the neuron.
ii. Binding to \( \text{GABA}_B \) receptors opens potassium channels.

**Ans. B: Chloride ion**  
*Ref.: Ganong’s Physiology, 23rd ed., p-120*

130. i. Alpha waves generally are seen in all age groups but are most common in adults.

They occur rhythmically on both sides of the head but are often slightly higher in amplitude on the nondominant side, especially in right-handed individuals.

A normal alpha variant is noted when a harmonic of alpha frequency occurs in the posterior head regions.

They tend to be present posteriorly more than anteriorly and are especially prominent with closed eyes and with relaxation.

Alpha activity disappears normally with attention (e.g., mental arithmetic, stress, opening eyes).

In most instances, it is regarded as a normal waveform.

An abnormal exception is alpha coma, most often caused by hypoxic-ischemic encephalopathy of destructive processes in the pons (e.g., intracerebral hemorrhage).

In alpha coma, alpha waves are distributed uniformly both anteriorly and posteriorly in patients who are unresponsive to stimuli.

ii. Beta waves are observed in all age groups.

They tend to be small in amplitude and usually are symmetric and more evident anteriorly.

Drugs, such as barbiturates and benzodiazepines, augment beta waves.

iii. Theta waves normally are seen in sleep at any age. In awake adults, these waves are abnormal if they occur in excess.

Theta and delta waves are known collectively as slow waves.

iv. **Delta waves** are slow waves have a frequency of 3 Hz or less.

They normally are seen in deep sleep in adults as well as in infants and children.

Delta waves are abnormal in the awake adult.

Often, they have the largest amplitude of all waves.

Delta waves can be focal (local pathology) or diffuse (generalized dysfunction).

**Ans. D: Deep sleep**  
*Ref.: Ganong’s Physiology, 23rd ed., p-234*

131. **Thermoregulation** in both ectotherms and endotherms is controlled mainly by the preoptic area of the anterior hypothalamus.

Such homeostatic control is separate from the sensation of temperature.

**Ans. D: Hypothalamus**  
*Ref.: Harrison’s Medicine, 17th ed., p-117*
132. Vomiting is believed to be controlled by two distinct brain centres—the **vomiting centre** and the chemoreceptor trigger zone—both **located in the medulla oblongata**.

The vomiting centre initiates and controls the act of emesis, which involves a series of contractions of the smooth muscles lining the digestive tract

**Ans. D:** Medulla

*Ref.:* Ganong’s Physiology, 23rd ed., p-474

133. In the case of the optic nerve and tracts there are three separate neurons linked together, extending from the retina to the occipital cortex.

The sensory end-organ consists of the rods and cones.

i. The first neuron begins in the outer plexiform or granular layer, and ends in the inner plexiform or granular layer. The cell-body governing the nutrition of this fiber is the bipolar cell, which cells forms the inner nuclear layer. This neuron, although extremely short is the true optic nerve in the physiological sense, and corresponds to the long fiber which runs from the sole of the foot up into the spinal cord.

ii. **The second neuron** in the retina begins in the inner nuclear layer and runs from here up to the primary optic ganglia, i.e., chiefly the external geniculate body. **This is the anatomical optic nerve.** The cell governing the nutrition of this fiber is the ganglion cell.

**Ans. B:** 2nd order neuron

*Ref.:* Parson’s Ophthalmology, 20th ed., p-29, 30

134. **Lateral spinothalamic tract carries fibers of all type of pain & temperature impulses (both hot & cold)**

**Spinothalamic tract**
- It transmits information to the thalamus about pain, **temperature**, itch and crude touch.
- The pathway decussates at the level of the spinal cord, rather than in the brainstem like the posterior column-medial lemniscus pathway and corticospinal tract.

**Posterior column-medial lemniscus pathway / dorsal column-medial lemniscus pathway / dorsal white column-medial lemniscus system**
- It is the sensory pathway responsible for transmitting **fine touch, vibration and conscious proprioceptive** information from the body to the cerebral cortex as well as tactile pressure, barognosis, graphesthesia, stereognosis, recognition of texture, kinesthesia and two-point discrimination.
- The name comes from the two structures that the sensation travels up: the posterior (or dorsal) columns of the spinal cord, and the medial lemniscus in the brainstem.
- Because the posterior columns are also called dorsal columns, the pathway is often called the **dorsal column-medial lemniscus system**, or DCML for short. (Also called posterior column-medial lemniscus or PCML pathway).
- The PCML is pathway is composed of rapidly conducting, large, myelinated fibers
- The pathway is tested with the Romberg’s test.
- Lesions to the posterior column-medial lemniscus pathway below the decussation of its fibers produce loss of sensation on the same side of the body as the lesion. Above the decussation produces loss of sensation on the opposite side of the body than the lesion

**Ans. C:** Heat sensation

*Ref.:* Ganong’s Physiology, 22nd ed., p-138, 142; AK Jain’s Physiology, 4th ed., p-914
135. Inferior parietal lobule (parietal lobe) helps in spatial recognition (tactile localization, tactile discrimination etc.)

**Spatial relationship**
- Recognition of spatial relationship is a function of angular gyrus (inferior parietal lobule)

**Temporal lobe**
- It is located beneath the Sylvian fissure on both cerebral hemispheres.
- The temporal lobe is involved in auditory perception and is home to the primary auditory cortex.
- It is also important for the processing of semantics in both speech and vision.
- The temporal lobe contains the hippocampus and plays a key role in the formation of long-term memory.
- The superior temporal gyrus includes an area (within the Sylvian fissure) where auditory signals from the cochlea (relayed via several subcortical nuclei) first reach the cerebral cortex.
- This part of the cortex (primary auditory cortex) is involved in hearing.
- Adjacent areas in the superior, posterior and lateral parts of the temporal lobes are involved in high-level auditory processing.
- This includes speech, for which the left temporal lobe in particular seems to be specialized.
- Wernicke’s area, which spans the region between temporal and parietal lobes, plays a key role (in tandem with Broca’s area, which is in the frontal lobe).
- The functions of the left temporal lobe are not limited to low-level perception but extend to comprehension, naming, verbal memory and other language functions.
- The underside (ventral) part of the temporal cortices appear to be involved in high-level visual processing of complex stimuli such as faces (fusiform gyrus) and scenes (parahippocampal gyrus).
- Anterior parts of this ventral stream for visual processing are involved in object perception and recognition.
- The medial temporal lobes are involved in episodic/declarative memory.
- Deep inside the medial temporal lobes lie the hippocampi, which are essential for memory function - particularly the transfer from short to long term memory and control of spatial memory and behavior.

Damage to this area typically results in anterograde amnesia.

**Ans. C: Spatial relationship**
*Ref.: Guyton’s Physiology, 12th ed., p-699t; AK Jain’s Physiology, 4th ed., p-1037, 1043*

**RESPIRATORY SYSTEM**

136. The immediate effect of decreased pressure causes decreased partial pressure of oxygen. Resulting hypoxemia, sensed by the carotid bodies, causes hyperventilation. However, hyperventilation also causes the adverse effect of respiratory alkalosis, inhibiting the respiratory center from enhancing the respiratory rate as a result of fall in Pco2.

In the short term, the human body undergoes hyperventilation, fluid loss (due to a decreased thirst drive and decrease in ADH), an increase in heart rate, and slightly lowered stroke volume. In the longer term, the body has lower lactate production (because reduced glucose breakdown decreases the amount of lactate formed), compensatory alkali loss in urine, decreased plasma volume, increased Hematocrit (polycythemia), increased RBC mass, a higher concentration of capillaries in skeletal muscle tissue, increased myoglobin, increased mitochondria, increased aerobic enzyme concentration, increase in 2,3-BPG, hypoxic pulmonary vasoconstriction, and right ventricular hypertrophy.

**Ans. A: Po2 is less**
*Ref.: Ganong’s Physiology, 23rd ed., p-618*
137. **Shunting of blood from the right side to the left side of the circulation (right-to-left shunt)** is a powerful cause of hypoxemia. The shunt may be intracardiac or may be intrapulmonary. It has been traditionally thought that this cause could be readily distinguished from the others as the only cause that cannot be corrected by the administration of 100% oxygen.

**Ans. A: R-L shunt**  
*Ref.*: Ganong’s Physiology, 23rd ed., p-620

138. Haemoglobin is the primary vehicle for transporting oxygen in the blood. The oxygen carrying capacity is determined by the amount of haemoglobin present in the blood. Oxygen is also carried dissolved in the blood’s plasma, but to a much lesser degree. A hemoglobin molecule can bind up to four oxygen molecules in a reversible way. The oxygen-hemoglobin dissociation curve has a sigmoidal or S-shape. The partial pressure of oxygen in the blood at which the hemoglobin is 50% saturated, is known as the P50. The P50 is a conventional measure of hemoglobin affinity for oxygen. An increased P50 indicates a rightward shift and a decreased affinity of the standard curve, which means that a larger partial pressure is necessary to maintain a 50% oxygen saturation. Conversely, a lower P50 indicates a leftward shift and a higher affinity.

Left shift of the curve is a sign of hemoglobin’s increased affinity for oxygen (e.g. at the lungs). Similarly, right shift shows decreased affinity, as seen in:

i. An increase in body temperature,
ii. An increase in hydrogen ion,
iii. An increase in 2,3-bisphosphoglycerate
iv. An increase in carbon dioxide concentration (the Bohr effect)

With fetal hemoglobin, the shift facilitates diffusion of oxygen across the placenta. The oxygen dissociation curve for myoglobin exists even further to the left.

**Ans. B: Decreased PaCO2**  
*Ref.*: Ganong’s Physiology, 23rd ed., p-611

139. Although the body requires oxygen for metabolism, low oxygen levels do not stimulate breathing. Rather, respiratory centre is directly stimulated by higher carbon dioxide levels or excess hydrogen ions in the blood. As a result, breathing low-pressure air or a gas mixture with no oxygen at all (such as pure nitrogen) can lead to loss of consciousness without ever experiencing air hunger.

The respiratory centers try to maintain an arterial CO₂ pressure of 40 mm Hg. With intentional hyperventilation, the CO₂ content of arterial blood may be lowered to 10-20 mm Hg (the oxygen content of the blood is little affected), and the respiratory drive is diminished.

**Ans. C: CO₂**  
*Ref.*: Guyton’s Physiology, 11th ed., p-516

140. The amount of air that moves into the lungs with each inspiration (or the amount that moves out with each expiration) is called the tidal volume (500 ml)  
The air inspired with a maximal inspiratory effort in excess of the tidal volume is the inspiratory reserve volume. (3000 ml)  
The volume expelled by an active expiratory effort after passive expiration is the expiratory reserve volume (1200 ml), and the air left in the lungs after a maximal expiratory effort is the residual volume (1200 ml).
The space in the conducting zone of the airways occupied by gas that does not exchange with blood in the pulmonary vessels is the respiratory dead space.

The vital capacity (4700 ml), the largest amount of air that can be expired after a maximal inspiratory effort, is frequently measured clinically as an index of pulmonary function. It gives useful information about the strength of the respiratory muscles and other aspects of pulmonary function (ERV+TV+IRV).

The fraction of the vital capacity expired during the first second of a forced expiration (FEV₁, timed vital capacity) gives additional information; the vital capacity may be normal but the FEV₁ reduced in diseases such as asthma, in which airway resistance is increased because of bronchial constriction.

The amount of air inspired per minute (pulmonary ventilation, respiratory minute volume) is normally about 6 L (500 mL/ breath x 12 breaths/min).

The maximal voluntary ventilation (MVV), or, as it was formerly called, the maximal breathing capacity, is the largest volume of gas that can be moved into and out of the lungs in 1 minute by voluntary effort. The normal MVV is 125–170 L/min.

Inspiratory Capacity (TV+IRV)=3500 ml

Functional Residual Capacity (RV+ERV)=2400 ml

Total Lung capacity (RV+VC)=5900 ml

Ans. B: Residual volume keeps alveoli inflated between breaths
Ref.: Ganong’s Physiology, 23rd ed., p-593

141. The decrease in O₂ affinity of hemoglobin when the pH of blood falls is called the Bohr effect and is closely related to the fact that deoxygenated hemoglobin (deoxyhemoglobin) binds H⁺ more actively than does oxyhemoglobin.

The pH of blood falls as its CO₂ content increases, so that when the PCO₂ rises, the curve shifts to the right and the P₅₀ rises.

Ans. D: Decrease in O₂ affinity of hemoglobin when the pH of blood falls
Ref.: Ganong’s Physiology, 23rd ed., p-611

142. Although the rhythmic discharge of medullary neurons concerned with respiration is spontaneous, it is modified by neurons in the pons and afferents in the vagus from receptors in the airways and lungs. An area known as the pneumotaxic center in the medial parabrachial and Kölliker–Fuse nuclei of the dorsolateral pons contains neurons active during inspiration and neurons active during expiration.

Stretching of the lungs during inspiration initiates impulses in afferent pulmonary vagal fibers. These impulses inhibit inspiratory discharge.

Ans. D: Decreased depth of respiration
Ref.: Ganong’s Physiology, 23rd ed., p-627

143. The low surface tension when the alveoli are small is due to the presence in the fluid lining the alveoli of surfactant, a lipid surface-tension-lowering agent.

Surfactant is a mixture of dipalmitoylphosphatidylcholine (DPPC), other lipids, and proteins. If the surface tension is not kept low when the alveoli become smaller during expiration, they collapse in accordance with the law of Laplace.
**Surfactant is produced by type II alveolar epithelial cells.** Typical lamellar bodies, membrane-bound organelles containing whorls of phospholipid, are formed in these cells and secreted into the alveolar lumen by exocytosis. Tubes of lipid called tubular myelin form from the extruded bodies, and the tubular myelin in turn forms the phospholipid film. Some of the protein–lipid complexes in surfactant are taken up by endocytosis in type II alveolar cells and recycled.

Surfactant is important at birth. The fetus makes respiratory movements in utero, but the lungs remain collapsed until birth. After birth, the infant makes several strong inspiratory movements and the lungs expand. Surfactant keeps them from collapsing again. Surfactant deficiency is an important cause of infant respiratory distress syndrome (IRDS, also known as hyaline membrane disease), the serious pulmonary disease that develops in infants born before their surfactant system is functional.

Maturation of surfactant in the lungs is accelerated by glucocorticoid hormones. Fetal and maternal cortisol increase near term, and the lungs are rich in glucocorticoid receptors.

Patchy atelectasis is also associated with surfactant deficiency in patients who have undergone cardiac surgery involving use of a pump oxygenator and interruption of the pulmonary circulation. In addition, surfactant deficiency may play a role in some of the abnormalities that develop following occlusion of a main bronchus, occlusion of one pulmonary artery, or long-term inhalation of 100% O₂. Cigarette smoking also decreases lung surfactant.

**Ans. D: Type II alveolar cells**
*Ref.:* Ganong’s Physiology, 23rd ed., p-597

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144. The Haldane effect is a property of hemoglobin first described by the Scottish physician John Scott Haldane. 

**Deoxygenation of the blood increases its ability to carry carbon dioxide; this property is the Haldane effect.** Conversely, oxygenated blood has a reduced capacity for carbon dioxide.

**Ans. C: Deoxygenation of blood increases capacity for carbon dioxide**
*Ref.:* Ganong’s Physiology, 22nd ed., p-669

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145. *An area in lower pons is referred to as apneustic centre & the activity of the neurons of this area is inhibited by afferents in the vagus nerve from the airway & lungs*

*If vagi are cut, arrest of respiration occurs in inspiration, called apneusis*

**Apneustic center**
- Situated in the lower pons
- It promotes inspiration by stimulation of the I-neurons in the medulla oblongata providing a constant stimulus.
- The apneustic center of pons sends signals to the dorsal respiratory center in the medulla to delay the ’switch off’ signal of the inspiratory ramp provided by the pneumotaxic center of pons.
- It controls the intensity of breathing.
- The apneustic center is inhibited by pulmonary stretch receptors.
- However, it gives positive impulses to the inspiratory (I) neurons.

**Apneustic respiration/ apneusis**
- It is an abnormal pattern of breathing characterized by deep, gasping inspiration with a pause at full inspiration followed by a brief, insufficient release.
• Accompanying signs and symptoms may include decerebrate posturing; fixed, dilated pupils; coma or profound stupor; quadriplegia; absent corneal reflex; absent doll’s eye sign; negative oculocephalic reflex; and obliteration of the gag reflex.
• **It is caused by damage to the pons or upper medulla** caused by strokes or trauma.
• Specifically, concurrent removal of input from the vagus nerve and the pneumotaxic center causes this pattern of breathing.
• It can also be temporarily caused by some drugs, such as ketamine.

**Ans. A:** Lower Pons  
*Ref.:* AK Jain’s Physiology, 4th ed., p-452

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146. *With increasing altitude, barometric pressure decreases, so the total pressure of the air decreases & \( p_{H2O} \) & \( p_{CO2} \) remains constant So \( p_{O2} \) & \( p_{N2} \) decreases progressively with height*

**High-altitude illness**

- Usually occurs at altitudes of over 1,500 m (4,921 ft)
- Caused primarily by hypoxia but is compounded by cold and exposure.
- Hypoxia is the main contributor to high-altitude illness.
- **Atmospheric pressure and the partial pressure of oxygen decrease rapidly at increasing levels above the earth's surface**
- \( p_{CO2} \) & \( p_{H2O} \) remain constant, \( p_{N2} \) also decreases
- It presents as one of three forms: acute mountain sickness (AMS), high-altitude pulmonary edema (HAPE) and high-altitude cerebral edema (HACE).
- Cardinal symptoms include dyspnea on exertion and at rest, cough, nausea, difficulty sleeping, headache and mental status changes.
- Treatment requires descent, and gradual acclimatization provides the most effective prevention.
- Acetazolamide is an effective preventive aid and can be used in certain conditions as treatment.

**Ans. A:** Low \( p_{O2} \)  
*Ref.:* Guyton’s Physiology, 12th ed., p-528t, AK Jain’s Physiology, 4th ed., p-479

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### REPRODUCTIVE SYSTEM

147. In *In Vitro* fertilization is a technique employed in cases of infertility. **Steps include removing mature ova, fertilizing it with sperm and implanting one or more of them back in uterus** at the four cell stage.

It has a 5-10% chance of producing a live birth

**Ans. C:** Removing mature ova, fertilizing it with sperm and implanting back in uterus  
*Ref.:* Ganong’s Physiology, 23rd ed., p-424

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148. **Ans. B:** LH  
*Ref.:* Ganong’s Physiology, 23rd ed., p-414
149. Hormonal control of Breast development and secretion and ejection of milk
   i. Progesterone — influences the growth in size of alveoli and lobes.
   ii. Oestrogen — stimulates the milk duct system to grow and become specific.
   iii. Follicle stimulating hormone
   iv. Luteinizing hormone
   v. Prolactin — contributes to the increased growth of the alveoli during pregnancy and formation of milk
   vi. Oxytocin — oxytocin contracts the smooth muscle layer of band-like cells surrounding the alveoli to squeeze the newly-produced milk into the duct system. **Oxytocin is necessary for the milk ejection reflex, or let-down to occur.**
   vii. Human placental lactogen (HPL) — This hormone appears to be associated with breast, nipple, and areola growth before birth.

Colostrum contains higher amounts of white blood cells and antibodies than mature milk, and is especially high in immunoglobulin A (IgA), which coats the lining of the baby’s immature intestines, and helps to prevent germs from invading the baby’s system.

**Ans. A: Oxytocin**

**Ref.:** Ganong’s Physiology, 23rd ed., p-426

150. Asymmetrical cell division (cytokinesis) leads to the production of polar bodies during oogenesis. To conserve nutrients, the majority of cytoplasm is segregated into either the secondary oocyte and, or ovum, during meiosis I or meiosis II, respectively.

The remaining daughter cells generated from the meiotic events contain relatively little cytoplasm and are referred to as polar bodies. Eventually, the polar bodies degenerate.

There may be one or two polar bodies in the ovum. **The first polar body is one of the two products in the first stage of meiosis, just before ovulation** and is considered diploid, with 23 duplicated chromosomes. The second polar body is haploid, with 23 unduplicated chromosomes and is produced only when a sperm penetrates the oocyte.

**Ans. B: Ovulation**

**Ref.:** Ganong’s Physiology, 23rd ed., p-412

151. Frequent physical signs indicating ovulation are:
   i. **Increased body temperature**
   ii. LH surge
   iii. **Increased cervical mucus** — cervical mucus is most abundant and becomes clear and slippery and stretches like egg white
   iv. Change of position and firmness of cervix
   v. Abdominal cramps (Mittelschmerz)
   vi. Increased libido
   vii. Tender breasts

**Ans. D: Fall in body temperature**

**Ref.:** Ganong’s Physiology, 23rd ed., p-414
152. On maturity of the ovum, the follicle and the ovary’s wall rupture, allowing the ovum to escape. The egg is caught by the fimbriated end and travels to the **ampulla where fertilization occurs**, the fertilized ovum, now a zygote, travels towards the uterus aided by activity of tubal cilia and activity of the tubal muscle.

**Ans. C: Ampulla**  
*Ref.: Ganong’s Physiology, 23rd ed., p-423*

153. Spermatozoa leaving the testes are not fully mobile. They continue their maturation and **acquire motility during their passage through the epididymis**.

Motility is obviously important in vivo, but fertilization occurs in vitro if an immotile spermatozoon from the head of the epididymis is microinjected directly into an ovum.

The ability to move forward (progressive motility), which is acquired in the epididymis, involves activation of a unique protein called CatSper, which is localized to the principal piece of the sperm tail.

**Ans. D: Epididymis**  
*Ref.: Ganong’s Physiology, 23rd ed., p-404*

154. **Asthenozoospermia**/“asthenospermia” is the term for **reduced sperm motility**.

It decreases the sperm quality and is therefore one of the major causes of infertility or reduced fertility in men.

**Ans. B: Reduction in motility of sperms**  
*Ref.: Shaw’s Gynecology, 13th ed., p-202*

155. The process of ovulation is controlled by the hypothalamus of the brain and through the release of hormones secreted in the anterior lobe of the pituitary gland, LH and FSH.

In the follicular (pre-ovulatory) phase of the menstrual cycle, the ovarian follicle will undergo a series of transformations called cumulus expansion, this is stimulated by the secretion of FSH. After this is done, a hole called the stigma will form in the follicle, and the ovum will leave the follicle through this hole.

Ovulation is triggered by a spike in the amount of FSH and LH released from the pituitary gland. During the luteal (post-ovulatory) phase, the ovum will travel through the fallopian tube toward the uterus.

If fertilized by a sperm, it may perform implantation there 6–12 days later.

In humans, the few days near ovulation constitute the fertile phase.

The average time of ovulation is the fourteenth day of an average length (twenty-eight day) menstrual cycle. It is normal for the day of ovulation to vary from the average, with ovulation anywhere between the tenth and nineteenth day being common, but **commonly occurs 14 days before the next cycle**.

Cycle length alone is not a reliable indicator of the day of ovulation.

**Ans. B: 14 days prior to next menstruation**  
*Ref.: Ganong’s Physiology, 23rd ed., p-412*

156. The **embryonic period** in humans begins at fertilization (12-24hrs after ovulation, generally **between the 2nd and 3rd week of gestational age**) and continues until the end of the **9th week of gestation** (8th week by embryonic age).

**Ans. B: 14 days to 9 weeks of gestation**  
*Ref.: OP Ghai’s Pediatrics, 7th ed., p-3 (Table 1.1)*
Physiological aspect:

i. The hypothalamus releases GnRH in a pulsatile nature which appears to be essential for stimulating the production and release of both luteinizing hormone (LH) and follicle stimulating hormone (FSH).

ii. LH and FSH are produced in the anterior pituitary and are secreted episodically in response to the pulsatile release of GnRH.

LH and FSH both bind to specific receptors on the Leydig cells and Sertoli cells within the testis. Testosterone, the major secretory product of the testes, is a primary inhibitor of LH secretion in males.

iii. Testosterone may be metabolized in peripheral tissue to the potent androgen dihydrotestosterone or the potent estrogen estradiol.

These androgens and estrogens act independently to modulate LH secretion.

The mechanism of feedback control of FSH is regulated by a Sertoli cell product called inhibin.

iv. Decreases in spermatogenesis are accompanied by decreased production of inhibin and this reduction in negative feedback is associated with reciprocal elevation of FSH levels.

v. Prolactin also has a complex inter-relationship with the gonadotropins, LH and FSH.

In males with hyperprolactinemia, the prolactin tends to inhibit the production of GnRH.

In individuals with elevated prolactin levels who are given testosterone, libido and sexual function do not return to normal as long as the prolactin levels are elevated.

Hormonal causes of impotency:

Hormone disorders account for fewer than 5% of cases of impotence.

**Testosterone deficiency**, which occurs rarely, can result in a loss of libido (sexual desire) and loss of erection.

Among other conditions, an excess of the hormone prolactin, caused by pituitary gland tumor, reduces levels of testosterone.

Hormone imbalances can also result from kidney or liver disease.

Other causes:

- **Mumps is known to cause testicular failure.**
- A varicocele can reduce hormonal production as well.

**Ans. D: All of the above**

**Ref.**: OP Ghai’s Pediatrics, 7th ed., p-188 (for option ‘a’), Internet resources

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**158. Leydig/ Interstitial cells secrete androgenic hormone testosterone at the time of puberty**

**Ans. A: Leydig cells**

**Ref.**: Ganong’s Physiology, 23rd ed., p-406; AK Jain’s Physiology, 4th ed., p-810

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**159. Leydig/ Interstitial cells secrete androgenic hormone testosterone at the time of puberty**

**Primary cell types of testes**

(A). Within the seminiferous tubules

- Here, germ cells develop into spermatogonia, spermatocytes, spermatids and spermatozoa through the process of spermatogenesis. The gametes contain DNA for fertilization of an ovum
- Sertoli cells - the true epithelium of the seminiferous epithelium, critical for the support of germ cell development into spermatozoa. Sertoli cells secrete inhibin.
(B). Between tubules (interstitial cells)
- Leydig cells - cells localized between seminiferous tubules that produce and secrete testosterone and other androgens important for sexual development and puberty, secondary sexual characteristics like facial hair, sexual behavior and libido, supporting spermatogenesis and erectile function. Testosterone also controls testicular volume.

Ans. B: Testosterone

160. The ovarian changes in menopause are not due to lack of anterior pituitary gonadotropins (FSH & LH) which actually increase, as negative effect of estrogen & progesterone is reduced. Ovaries no longer secrete 17-beta-estradiol

Menopause
- The stages of the menopause transition have been classified according to a woman’s reported bleeding pattern, supported by changes in the pituitary follicle stimulating hormone/ FSH levels.
- In younger women, during a normal menstrual cycle the ovaries produce estradiol, testosterone and progesterone in a cyclical pattern under the control of FSH and luteinising hormone (LH) which are both produced by the pituitary gland.
- Blood estradiol levels remain relatively unchanged, or may increase approaching the menopause, but are usually well preserved until the late perimenopause.
- This is presumed to be in response to elevated FSH levels.
- Menopause is based on the natural or surgical cessation of estradiol and progesterone production by the ovaries, which are a part of the body’s endocrine system of hormone production, in this case the hormones which make reproduction possible and influence sexual behavior.
- After menopause, estrogen continues to be produced in other tissues, notably the ovaries, but also in bone, blood vessels and even in the brain.
- However the dramatic fall in circulating estradiol levels at menopause impacts many tissues, from brain to skin.
- In contrast to the sudden fall in estradiol during menopause, the levels of total and free testosterone, as well as dehydroepiandrosterone sulfate (DHEAS) and androstenedione decline more or less steadily with age.

Ans. B: FSH

MISCELLANEOUS

161. Unitary smooth muscle (as present in a walls of a hollow viscus) is characterized by the instability of its membrane potential and by the fact that it shows continuous, irregular contractions that are independent of its nerve supply.

This maintained state of contraction is called tonus/tone

It does have actin and myosin-II but they are not arranged in regular arrays to give striations as in skeletal and cardiac muscle.

They require calcium for initiation of contraction like skeletal and cardiac muscle.

Ans. C: It contracts when stretched in the absence of any extrinsic innervation
Ref.: Ganong’s Physiology, 23rd ed., p-109,110
Plasm osmolality is a measure of the concentration of substances such as sodium, chloride, potassium, urea, glucose, and other ions in blood.

**Osmolal concentration of plasma is 290 mOsm/L**

Osmolality of blood increases with dehydration and decreases with overhydration.

In normal people, increased osmolality in the blood will stimulate secretion of antidiuretic hormone (ADH). This will result in increased water reabsorption, more concentrated urine, and less concentrated blood plasma.

A low serum osmolality will suppress the release of ADH, resulting in decreased water reabsorption and more concentrated plasma.

**Ans. C: 280-290 mOsm/L**

Ref.: Ganong’s Physiology, 23rd ed., p-6

**Cells of proximal and distal tubules secrete hydrogen ions** which comes from carbonic acid

For each hydrogen ion secreted, one sodium ion and one bicarbonate ion enters the interstitial fluid.

**Ans. A: Kidney**

Ref.: Ganong’s Physiology, 23rd ed., p-679

**In neurons resting membrane potential is about -70 mV, which is close to the equilibrium potential of potassium ions**

**Ans. A: Potassium**

Ref.: Ganong’s Physiology, 23rd ed., p-84

**Metabolic acidosis** occurs when the body produces too much acid, or when the kidneys are not removing enough acid from the body.

1. Diabetic acidosis
2. Hyperchloremic acidosis results from excessive loss of sodium bicarbonate from the body.
3. Lactic acidosis is a buildup of lactic acid-alcohol, cancer, liver failure, low blood sugar.

Common mnemonic is mudpile

M - Methanol
U - Uremia
D - **Diabetic Ketoacidosis** (also alcohol ketosis, starvation ketosis)
P - Para-aldehyde
I - Isoniazid, Iron, Inborn Errors of Metabolism
L - Lactic Acid
E - Ethylene Glycol
S – **Salicylates**

**Ans. B: Emphysema**

Ref.: Ganong’s Physiology, 23rd ed., p-615

**Ans. C: Sodium ion**

Ref.: Ganong’s Physiology, 23rd ed., p-106
167. While isometric training increases strength at the specific joint angles of the exercises performed and additional joint angles to a lesser extent, **dynamic exercises increase strength throughout the full range of motion.**

Generally speaking however, people who train isometrically don’t train through a full range of motion as the strength gained at the training joint angle is where they require it. While dynamic exercises are slightly better than isometric exercises at enhancing the twitch force of a muscle, isometrics are significantly better than dynamic exercises at increasing maximal strength at the joint angle.

Flexibility may be increased when isometrics are performed at joint range of motion extremes.

**Ans. C: Isotonic**

*Ref*: Ganong’s Physiology, 23rd ed., p-101

168. The **nicotinic cholinergic receptors are found in the neuromuscular junctions** of somatic muscles; stimulation of these receptors causes muscular contraction. They are also found in the **autonomic ganglia of autonomic nervous system and central nervous system**

Muscarinic receptors are found in:
- M 1-brain
- M 2-heart
- M 3-smooth muscle
- M 4-smooth muscle, pancreatic acinar and islet tissue

**Ans. C: Bronchial Smooth Muscle**

*Ref*: Ganong’s Physiology, 23rd ed., p-135

169. **Ans. A: 80-110**


170. **BMI=Weight/Height**
   i. Less than 18.5- **underweight**
   ii. 18.5-24.9- Normal
   iii. 25-29.9- Overweight
   iv. More than 30- Obese

**Ans. A: Less than 18.5**

*Ref*: Harrison’s Medicine, 17th ed., p-A-452

171. Intracellular component of the body water accounts for about 40% of body weight and extracellular component for about 20%.

**Concentration of potassium in cytosol is 139 millimeter** and of Amino acids (in proteins) is 138 millimeter,

**Ans. C: Potassium**

*Ref*: Ganong’s Physiology, 23rd ed., p-3(Fig.-1.1-B)

172. When tissue is damaged, platelets adhere to exposed matrix via integrins that bind to collagen and laminin. Blood coagulation produces thrombin, which promotes platelet aggregation and granule release. The platelet granules generate an inflammatory response.
White blood cells are attracted by selections and bind to integrins on endothelial cells, leading to their extravasation through the blood vessel walls. Cytokines released by the white blood cells and platelets up-regulate integrins on macrophages, which migrate to the area of injury, and on fibroblasts and epithelial cells, which mediate wound healing and scar formation. Plasmin aids healing by removing excess fibrin. This aids the migration of keratinocytes into the wound to restore the epithelium under the scab. Collagen proliferates, producing the scar.

Wounds gain 20% of their ultimate strength in 3 weeks and later gain more strength, but they never reach more than about 70% of the strength of normal skin.

**Ans. C: 3 weeks of wound healing**

Ref.: Ganong’s Physiology, 23rd ed., p-3 (Fig.-1.1-B)

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173. **All but about 20 of the 290 mosm in each liter of normal plasma are contributed by Na⁺ and its accompanying anions, principally Cl⁻ and HCO₃⁻.** Other cations and anions make a relatively small contribution. Although the concentration of the plasma proteins is large when expressed in grams per liter, they normally contribute less than 2 mosm/L because of their very high molecular weights. The major nonelectrolytes of plasma are glucose and urea, which in the steady state are in equilibrium with cells. Their contributions to osmolality are normally about 5 mosm/L each but can become quite large in hyperglycemia or uremia. The total plasma osmolality is important in assessing dehydration, overhydration, and other fluid and electrolyte abnormalities. Hyperosmolality can cause coma (hyperosmolar coma).

**Ans. A: Sodium**

Ref.: Ganong’s Physiology, 23rd ed., p-6

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174. During prolonged starvation, **keto acids derived from fats are used by the brain** and other tissues. Most of the protein burned during total starvation comes from the liver, spleen, and muscles and relatively little from the heart and brain. The blood glucose falls somewhat after liver glycogen is depleted, but is maintained above levels that produce hypoglycemic symptoms by gluconeogenesis. Ketosis is present, and neutral fat is rapidly catabolized. When fat stores are used up, protein catabolism increases even further, and death soon follows.

**Serum albumin level is reduced but it stays above 2.8 g/dL**

**Ans. D: Level of serum proteins less than 2.8 g/dL**

Ref.: Harrison’s Medicine, 17th ed., p-450

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175. The Na⁺ channels rapidly enter the inactivated state and remain in this state for a few milliseconds before returning to the resting state. In addition, the direction of the electrical gradient for Na⁺ is reversed during the overshoot because the membrane potential is reversed, and this limits Na⁺ influx. A third factor producing repolarization is the opening of voltage-gated K⁺ channels.

**The net movement of positive charge out of the cell due to K⁺ efflux at this time helps complete the process of repolarization.**

The slow return of the K⁺ channels to the closed state also explains the after-hyperpolarization.

**Ans. B: Potassium ions**

Ref.: Ganong’s Physiology, 23rd ed., p-85
176. **Ans. D: IL5**  
*Ref.: Ganong’s Physiology, 23rd ed., p-68 (Table 3-2)*

177. **Ans. D: Both of the above**  
*Ref.: Ganong’s Physiology, 23rd ed., p-616*

178. **Decreasing the external Na\(^+\) concentration decreases the size of the action potential** but has little effect on the resting membrane potential. The lack of much effect on the resting membrane potential would be predicted, since the permeability of the membrane to Na\(^+\) at rest is relatively low.  
Conversely, increasing the external K\(^+\) concentration decreases the resting membrane potential.  
A decrease in extracellular Ca\(_{2+}\) concentration increases the excitability of nerve and muscle cells by decreasing the amount of depolarization necessary to initiate the changes in the Na\(^+\) and K\(^+\) conductance that produce the action potential. Conversely, an increase in extracellular Ca\(_{2+}\) concentration “stabilizes the membrane” by decreasing excitability.  
**Ans. A: Lower extracellular sodium**  
*Ref.: Ganong’s Physiology, 23rd ed., p-85*

179. **Ans. D: Sodium ions**  
*Ref.: Ganong’s Physiology, 23rd ed., p-318*

180. Deficiency of:  
i. Thiamine causes Beri Beri, neuritis  
ii. Pyridoxine causes Convulsion, hyperirritability  
iii. **Folic acid** causes sprue, Anemia and **neural tube defect in the newborn born to folate-deficient mothers**  
v. Cyanocobalamin causes pernicious anemia, loss of vibration and position sense, dementia, abnormal gait  
**Ans. C: Folic acid**  
*Ref.: Ganong’s Physiology, 23rd ed., p-465*

181. **Ans. D: More than 30**  
*Ref.: Harrison’s Medicine, 17th ed., p-A-452*

182. **Ans. B: Pre senile**  
*Ref.: Internet resources*

183. **Biological membranes typically include** several types of lipids other than phospholipids.  
A particularly important example in animal cells is **cholesterol**, which helps strengthen the bilayer and decrease its permeability.  
Cholesterol also helps regulate the activity of certain integral membrane proteins.  
Integral membrane proteins function when incorporated into a lipid bilayer.  
Because bilayers define the boundaries of the cell and its compartments, these membrane proteins are involved in many intra- and inter-cellular signaling processes.  
**Ans. B: Cholesterol**  
*Ref.: Harper’s Biochemistry, 28th ed., p-408*
184. The meibomian glands (or tarsal glands) are a special kind of sebaceous glands at the rim of the eyelids inside the tarsal plate, responsible for the supply of meibum, an oily substance that prevents evaporation of the eye’s tear film, prevents tear spillage onto the cheek, makes the closed lids airtight and acts as a blockade for tear fluid, trapping tears between the oiled edge and eyeball.

Ans. B: Meibomian gland
Ref.: Internet resources

185. Remember:
   i. ICF is more abundant than ECF
   ii. ECF contains large amounts of sodium and chloride ions
   iii. ICF contains large amount of potassium ions and phosphate ions

Ans. C: High sodium to potassium ratio is seen in ECF
Ref.: Guyton’s Physiology, 11th ed., p-293-296

186. Red reaction or red line in triple reaction is due to dilatation of precapillary sphincters

Triple response of Lewis
- It is a cutaneous response that occurs from firm stroking of the skin, which produces an initial red line, followed by a flare around that line, and then finally a wheal.
- The triple response of Lewis is due to the release of histamine.
- Histamine, or 2-(imidazol-4-yl) ethanamine, is a dibasic vasoactive amine that is located in most body tissues but is highly concentrated in the lungs, skin, and gastrointestinal tract.
- Histamine is derived from the decarboxylation of the aminoacid histidine, a reaction catalyzed by the enzyme L-histidine decarboxylase.
- Histamine is a small molecule, stored as granules in mast cells and basophils.
- Mast cells and basophils are the effector cells involved in the immediate hypersensitivity response.
- Explanation: Injected intradermally histamine elicits the triple response consisting of:
  - Red spot: due to capillary dilation
  - Flare: Redness in the surrounding area due to arteriolar dilatation mediated by axon reflex.
  - Wheal: due to exudation of fluid from capillaries and venules

Ans. B: Capillary dilation

187. During exposure to positive ‘g’ for the first few seconds, blood is thrown into the lower parts of the body, therefore, venous return to heart decreases resulting in fall in cardiac output and systolic BP

Angular acceleration or centrifugal force.
- If a fighter pilot is diving at the rate of 450 miles an hour and pulls out of this dive on the arc of a circle having a radius of about one-half mile, centrifugal force will press his body down onto the seat of the plane with a force which will be slightly more than five times the force of gravity.
- Thus if the flyer’s weight is 180 lbs., the force of his body against the seat of the plane would equal more than 900 lbs.
- His arms would be so heavy that he would be unable to lift them.
The blood would have a weight five times its normal value. This would make it difficult for the Heart to pump an adequate amount of blood to the brain. Blood would, therefore, tend to drain out of the upper part of the body and become pooled in the abdomen and the legs, and the aviator would suffer from cerebral ischemia. The first effect of this ischemia would be a blurring and graying of the vision as though a semi-transparent curtain were lowered before the eyes. This would be accompanied by a narrowing of the visual field. If the centrifugal force on the body is continued or increased, the aviator will “black out,” that is, he will suffer a complete loss of vision and finally will lose consciousness. The extent of the physiological changes produced depends upon both the magnitude and duration of the centrifugal force applied to the body.

Ans. D: Pooling of blood in lower body

188. When the motor nerve to a skeletal muscle is cut, it causes disuse atrophy of the muscle, complete paralysis of the muscle, fibrillations, abnormal excitability of the muscle & increased sensitivity to circulating acetylcholine (denervation hypersensitivity)

Fibrillation
- It happens when muscle fibers lose contact with their innervating axon producing a spontaneous action potential, “fibrillation potential” that results in the muscle fiber’s contraction.
- These contractions are not visible under the skin and are detectable through needle electromyography (EMG) and ultrasound.
- Fibrillations do not occur in healthy individuals.
- They are a major symptom in acute and severe peripheral nerve disorders, in myopathies in which muscle fibers are split or inflamed, and lower motor neuron lesions.

Fasciculations
- They are visible spontaneous contractions involving small groups of muscle fibers.
- Fascication does not necessarily denote pathology, as does fibrillation, although it can be seen in lower motor neuron lesions as well.

Ans. D: Strong stimulus